The Treatise Committee for Usamah K. Muhammad-Rodgers Certifies that this is the approved version of the following Treatise:

Addressing the Skills Gap: A Qualitative Study of Industry Partners Supporting Pathways in Technology Early College High Schools

Committee:

Joshua Childs, Supervisor

Ruben Olivarez

Norma Cantu

Lew Blackburn

Addressing the Skills Gap: A Qualitative Study of Industry Partners Supporting Pathways in Technology Early College High Schools

by

Usamah K. Muhammad-Rodgers

Treatise

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Education

The University of Texas at Austin

May 2020

Dedication

I dedicate this to my family and friends that persevered with me throughout this journey. First, to my parents Safiyyah Muhammad and Kedar Muhammad, you have been my biggest cheerleaders. Your support and encouragement helped me to keep pushing. To my children, Ayesha and Armon, you inspired me to finish strong. I hope that my determination to finish despite the obstacles encountered teaches you that by working hard and staying the course you can achieve your goals.

To my friend Ashley Duncan, thank you for your tough love when I needed it and genuinely celebrating each milestone accomplished along the way. Lastly, to my prayer partner M. Erlene Williams, thank you so much for praying for me when I did not have the words or the strength to pray for myself. Many thanks to each of you for your love, support and encouragement, you truly are the wind beneath my wings.

Acknowledgements

I am grateful for the love, support and encouragement of my family and friends throughout my doctoral journey. This process has been both challenging and rewarding. My village was a source of motivation and inspiration; and I am truly grateful for each person that encouraged me along the way. First, Dr. Jasmine Parker, thank you for sharing your knowledge, and assisting me with getting started. The first step was most definitely the hardest. Dr. Cody Arvidson, thank you for keeping me on-track and pushing me to stay the course. Thank you to the many CSP members that inquired about my journey, gave advice and encouraged me to finish strong. I appreciate each of you and I am honored to be counted among such distinguished educators.

Thank you to my committee members, words cannot fully express my gratitude. Dr. Joshua Childs, thank you for your guidance and direction. I appreciate your coaching and feedback. You exemplify servant leadership. Dr. Norma Cantu, thank you for serving on my committee, being such a supportive professor and great role model. Dr. Lew Blackburn, thank you for always championing my work. I appreciate you and Donna for your assistance and support. Lastly, Dr. Rubén Olivárez, thank you for your leadership. Your nuggets of wisdom continuously permeate my thinking and I look forward to "charging on".

Abstract

Addressing the Skills Gap: A Qualitative Study of Industry Partners Supporting Pathways in Technology Early College High Schools

Usamah K. Muhammad-Rodgers, Ed.D.

The University of Texas at Austin, 2020

Supervisor: Joshua Childs

Pathways in Technology Early College High Schools (P-TECH) not only prepare students for postsecondary study but also support economic development by preparing students to enter the workforce. The purpose of this qualitative study was to interview P-TECH industry partners to gain a deeper understanding of their experiences and perspective regarding how current programs have been implemented, their roles in these partnerships, and workforce outcomes. There were three research questions: (a) What are industry partners' perceptions of how the P-TECH program prepares students to enter STEM related careers? (b) What are industry partners' perceptions of how the school district engages business and industry partners in developing career pathways which align with Texas HB5 requirements? (c) What do industry partners perceive as successes and challenges associated with the P-TECH program? The study gave voice to the industry partners who experienced the industry-partnership aspect of the P-TECH program phenomena firsthand. There were six participants who represented six industry partners

of the P-TECH program operating in a large school district in Texas interviewed. Coding involved constructing an in-depth description of the experience. Pseudonyms and masking were used for the final presentation of the findings. The seven themes that emerged from the data follow as: (a) value alignment, (b) future employment opportunities and skills mapping, (c) mentoring and workplace learning experiences, (d) champions, (e) effective communication, (f) positive experiences, and (g) opportunities for improvement derived from the participants' responses. This study's findings offer a deeper understanding of the industry partner experience and might assist superintendents in identifying best practices for building strategic partnerships that ensure the longevity of successful P-TECH programs that prepare graduates to streamline from education into the workforce.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

College and career readiness are key priorities for educators, policymakers, and workforce communities (Balestreri et al., 2014, Bragg & Taylor, 2014, Gewertz, 2010). Conley (2008) defines college readiness as "the level of preparation a student needs in order to enroll and succeed in a credit bearing general education course at a post-secondary institution" p.24. Also, career readiness can be, "an indicator of whether students are equipped with the skills and attributes they need to successfully seek and obtain gainful employment" (Totura, 2013, p. 2). Presently, there is a growing demand for science, technology, engineering, and mathematics (STEM) professionals and to bridge the gap stakeholders in education and STEM industries are considering more holistic education options that prepare students for postsecondary education and the workforce (IBM, 2012). Consequently, educators, policymakers, and industry professionals are working to implement policies or programs to address the challenge.

In Texas, House Bill 5 (HB5, 2013) established the state Foundation High School Program which provides an opportunity for students to earn endorsements in specific areas of study inclusive of STEM. The bill was enacted to help ensure students obtain the skills necessary to enroll in post-secondary education or procure employment (Aycock & Davis, 2014). Additionally, public school districts in Texas are implementing innovative programs to equip students with the knowledge and skills to transition into college or a career successfully. One such program is Pathways in Technology Early College High Schools (P-TECH). P-TECHs are formed based upon a partnership between high school, college, and industry partners. The first P-TECH opened in 2011 at Paul Robeson High

School in Brooklyn, New York, through the collaborative efforts of IBM, New York City Department of Education, City University of New York, and New York City College of Technology (Gale, 2018). Globally, the P-TECH initiative has grown to include more than 100 schools in eight states (New York, Illinois, Connecticut, Maryland, Colorado, Rhode Island, Texas and Louisiana) and three countries; Australia, Morocco, and Taiwan (P-TECH, 2019). The Texas Education Agency (TEA, 2019) designated the first P-TECH schools in Texas during the 2018-2019 school year and the following school year the number of designated P-TECH schools grew from 34 to 63.

The P-TECH model is an early college high school model with specific purposes to:

1. Address the "skills gap" and strengthen regional economies by building a workforce with the academic, technical and professional skills required for middle skill level jobs and
2. Provide underserved youth with an innovative education opportunity with a direct pathway to college attainment and career readiness. (P-TECH, 2019, para. 4)

P-TECHs enlist the support of industry partners who agree to mentor students, provide internships and offer P-TECH students priority in interviews for employment following graduation. P-TECH industry partners support the program by committing to implement the model according to the framework outlined within the memorandum of understanding (MOU).

The MOU formalizes the partnership and details the role and responsibilities for each entity. Industry partners agree to the following:

A. Providing an industry liaison which is an employee from the company assigned to the high school to support implementation of the program
B. Developing a skills map a document that outlines the professional skills required for entry level employment
C. Providing students with work experiences that include mentoring, site visits, speakers, project days and paid internships
D. Committing to provide P-TECH graduates first priority in job interviews
E. Collaborating with high school and college partners to ensure that work experiences are integrated with high school and college coursework. (IBM, 2012, p. 12).

P-TECH industry partnerships provide students with direct exposure to industry professionals in STEM fields in order to equip graduates with the knowledge and skills to transition into the workforce successfully (Figure 1).

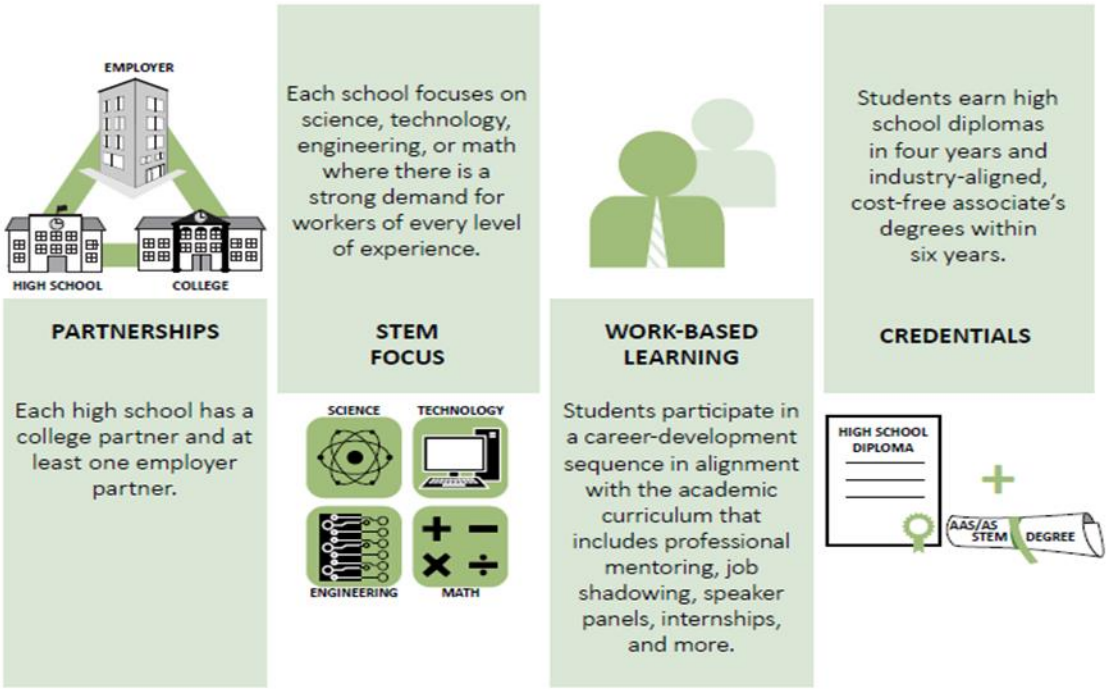


Figure 1. P-TECH model as presented by MDRC (2018).

One large urban school district in Texas has taken P-TECH to scale by implementing the program as a school within a school at 18 comprehensive high schools throughout the district. The district's P-TECH program consists of partnerships with 7 community colleges and 77 industry partners. The first cohort of students in the district's P-TECH program graduated from eight high schools in May 2020. The P-TECH concept is relatively new and was quickly taken to scale. Thereby, creating the need to assess the model's sustainability, students' employment opportunities and outcomes, students' levels of preparedness to enter the STEM workforce, and the reliability and satisfaction of industry partners (Abdul-Alim, 2017; Grand, 2017).

Statement of the Problem

Currently, there are 6.6 million job seekers and 6.0 million job openings in the United States; however, there is a 'skills gap' the difference between skills job creators need and the skills job seekers offer, leaving many jobs unfilled (US Department of Labor, 2018). The skills gap primarily consists of jobs that may not need a 4-year degree but do need some postsecondary training. According to Symonds et al. (2011):

> The total number of jobs in America has grown by 63 million, the number of jobs held by people with no post-secondary education has decreased by 2 million jobs. Thus, over the past third of a century, all of the net job growth in America has been generated by positions that require at least some post-secondary education. (p. 2)

The skills gap can be addressed by training high school students to work in jobs requiring some postsecondary training and considered middle skill level. Middle skill level professions include jobs such as network administrators, computer technicians, machinists, financial analysts, and healthcare technicians (Burrowes et al., 2014). These job titles suggest middle skill level jobs require more education and training than a high school diploma but less than a 4-year college degree. There is a shortage of people qualified for these positions thereby creating a skills gap (Symonds et al., 2011).

Companies cite fears about the availability of skilled labor (Autor, 2015; Future of Jobs Report, 2018; Tyszko, Sheets, & Fuller, 2014). Burrowes et al. (2014) noted that "when businesses come up against hard-to-fill middle-skills jobs, they face hidden costs such as lost output, increased overtime, inability to grow and compete, and higher

turnover" (p. 16). College students are also impacted by the skills gap. "Only 36% of full-time students enrolled at four-year research universities, 19% at all other universities, and 4% of students at two-year institutions graduate on time. For those who do graduate, nearly 54% of bachelor's degree holders age 25 and under are either unemployed or underemployed" (Tyszko et al., 2014, p. 6).

According to Matthews and Yongpradit (2019), the United States will not be able to keep up with the growing demand for skilled workers in information technology (IT) and computer science (CS) unless something changes. In the report Addressing America's Growing Demand for Information Technology and Computer Science: The Case for Change in K–12 Education the authors state, "there are more than 150,000 unfilled IT [information technology] support jobs in the U.S." (Matthews & Yongpradit, 2019 p. 4). Given the demand for a more skilled workforce and the need to improve post-secondary completion rates, school districts are working to increase the number of students who have access to post-secondary education prior to high school graduation. The academic benefits of students participating in dual enrollment programs include increased academic rigor during the junior and senior years of high school, overall academic success for students, and facilitation of the transition between high schools and colleges (Jones, 2013). The most common programs implemented which allow students to earn college credit while in high school are International Baccalaureate (IB), Advanced Placement (AP), and dual enrollment. AP, IB, and dual enrollment programs provide high school students with an opportunity to complete college coursework and earn college credit; however, these programs do not specifically address the growing demand for

middle skill level professionals in STEM fields. The P-TECH program emerged as an alternative for fast tracking students into their careers upon dual high school and community college graduation (IBM, 2012).

Schools seeking to implement P-TECH programs in Texas must obtain designation by applying to TEA. The designation process was established to ensure that school districts maintain the integrity of the P-TECH model (TEA, 2018). School districts earn P-TECH designation by submitting documentation to demonstrate implementation of the program in accordance with the guidelines contained in the TEA (2018) P-TECH Blueprint. For example, the TEA P-TECH Blueprint calls for industry partners guide educators through a skills mapping process which identifies the skills required for entry-level jobs targeted for students graduating from P-TECHs.

After the workplace skills are identified, they are utilized to develop a 6-year plan to educate students to perform those skills. The P-TECH curriculum is derived from the partners' workplace and employment needs (IBM, 2012). Prior to this study, there was little substantial evidence of P-TECH program success from the perspectives of industry partners regarding whether their demand for middle skill level professionals was met. The study was based on the information provided in the literature and the extremely limited outcome studies (Giani, Alexander, & Reyes, 2014; Haxton et al., 2016; Hoffman, Vargas, & Santos, 2009).

College access programs provide increased opportunities for high school students to earn college credit hours in high school; however, P-TECH programs are needed to address the growing demand for middle skill level professionals in STEM fields. Industry

partners have pivotal roles in the success of P-TECHs. The benefits to students who graduate from P-TECHs appear to be obvious; however, the benefits to the industry partners need to be explored. Data from industry partners may be used to determine if P-TECHs within the district are successfully preparing graduates for middle skill level jobs across the region.

Purpose of the Study and Research Questions

The purpose of this study is to interview P-TECH industry partners to gain a deeper understanding of their experiences and perspective regarding how current programs have been implemented, their roles in these partnerships, and workforce outcomes. Therefore, data were collected to determine what experiences the industry partners had and what value they associated with their P-TECH partner schools. The purpose of the qualitative study was fulfilled by answering the following three research questions:

1. What are industry partners' perceptions of how the P-TECH program prepares students to enter STEM careers?
2. What are industry partners' perceptions of how the school district engages business and industry partners in developing career pathways which align with Texas HB5 requirements?
3. What do industry partners perceive as successes and challenges associated with the P-TECH program?

Significance of the Study

The demand for STEM jobs was growing at a faster rate than overall employment; simultaneously, the skills demanded by STEM employers evolve much faster than education systems can adapt (Grand, 2017). In 2013, Texas House Bill 5 replaced the high school graduation plan with a new structure which requires students to select at least one of five endorsements; STEM, Business and Industry, Public Service, Arts and Humanities or Multidisciplinary. The new Texas Foundation Graduation Plan reduced the overall core requirements of the previous graduation plan and broadened the scope of career and technical education course offerings as a means to increase workforce preparation (Latham-Sikes, 2017).

Moreover, in 2016, the TEA, Texas High Education Coordinating Board (THECB), and Texas Workforce Commission (TWC) were charged to work collaboratively to develop a plan that connected education and industry, with the goal of helping Texas grow in economic prosperity (TEA, 2016). The overarching goal of the plan is to increase the percent of 25- to 34-year-olds in Texas who hold a certificate or degree from 38% to 60% by 2030 (Latham-Sikes, 2017). TEA also worked collaboratively with the TWC and the THECB to establish the Texas P-TECH program in order to address regional workforce needs, course credit transfer policies between institutions of higher education and create internships, apprenticeships, and other work-based education programs for P-TECH students (TEA, 2018). TEA also developed a competitive grant program to provide funding for school districts within the state to

launch P-TECH programs. As a result, superintendents began plans to add P-TECH programs to their school district's library of curricula.

With superintendents seeking to access funding to implement P-TECH programs, there was a need to provide a deeper understanding of the P-TECH from the perspective of industry partners. Superintendents who play a central role in innovative policy development in education need information on programs like P-TECH that can influence workforce development policy. Superintendents who engage in P-TECH development might benefit from understanding how to maximize the funds allocated to training and education programs that the target high-demand jobs found in the STEM fields that include information technology and healthcare (Olsen, Hora, & Benbow, 2014).

P-TECH programs require partnerships between high schools, colleges, and industries. P-TECH partnerships are established by a formal agreement that must include a six-year curriculum culminating in an industry-recognized Associate of Science (AS) degree or Associate of Applied Science (AAS) degree; work-site visits and activities leading to internships; mentoring; incorporation of academic, technical and workplace skills; and other structural components required to implement the program successfully (Public Policy Institute, 2016). Superintendents need information about implementing P-TECH programs, given that states like Texas have allocated money specifically for launching P-TECHs (TEA, 2019).

By understanding the partners' perspectives, superintendents may gain valuable insight about planning for opening a P-TECH that is attractive to industries needing graduates with middle level skills. The industry partners' experiences with P-TECH

programs might provide superintendents with relevant information about effectively engaging with industry partners to support students in developing workplace learning skills. Additionally, the study added to the body of knowledge about P-TECH which was limited due to the cutting-edge nature of its design.

Conceptual Framework

The study was conducted based upon a conceptual framework guided by IBM's (2012) P-TECH design principles and the strategic partnerships conceptual framework by Eddy and Amey (2014). These models were synthesized together as an integrated conceptual framework that guided this qualitative study. First, IBM's P-TECH design principles were the following:

1. Building an effective partnership,
2. Leading with a clear vision and shared decision making,
3. Designing a rigorous and focused curriculum,
4. Creating an integrated college experience,
5. Creating an integrated workplace experience,
6. Building a strong and collaborative teaching faculty,
7. Fostering family and community engagement and
8. Using resources purposefully. (p. 5)

In the STEM Pathways to College and Careers Schools Development Guide, IBM (2012) advised:

> When the collaborators began planning P-TECH in September 2010, the goal was never to create a single school. Rather, the express intent was to create an

> innovative, replicable model for education one that united the expertise of the public and private sectors to provide new opportunities for young people and addressed the need to strengthen the continuum from school to college and careers. (p. 1)

Second, the strategic partnership model, developed by Eddy and Amey (2014) was included in the conceptual framework because P-TECH programs require partnerships between and among K-12 educational institutions, higher education, and industry partners. The first P-TECH was established to demonstrate the capability of K-12 schools, higher education institutions, and public-private partnerships to substantially increase graduation rates, prepare greater numbers of students to fill jobs in the information technology field, and enable more students to pursue postsecondary education successfully (IBM, 2012). Consequently, successful implementation of the P-TECH program required partnerships between and among the collaborating institutions through the development of effective collaborations. Amey, Eddy, and Campbell (2010) stated:

> Educators working together across institutional levels can provide smooth pathways and options for students who have been historically disabled by the traditional systems and structures that make it difficult for them to find creative options, develop support networks, address their diverse learning needs, and identify alternative strategies that will assist them in the pursuit of their educational goals. (p. 335)

Strategic partnerships are formed based upon a common purpose and for the joint contribution in helping leaders meet institutional goals and objectives (Eddy & Amey, 2014). The strategic partnership model has the three phases of prepartnership, partnership development, and partnership capital (Eddy & Amey, 2014). Figure 2 provides a visual depiction of the model.

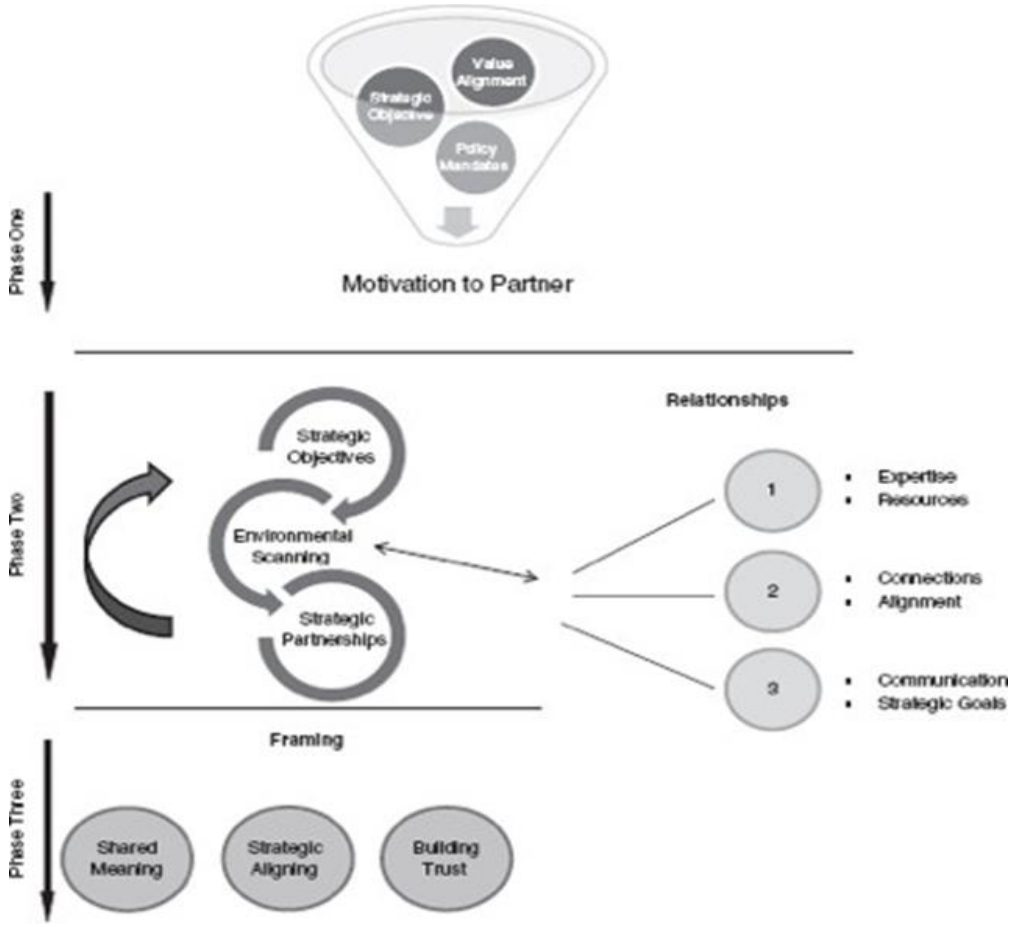


Figure 2. Strategic partnership model components and phases by Eddy and Amey (2014), reprinted with permission.

The first phase in the model includes the antecedents for each of the partners that contribute to the motivation to partner (Amey et al., 2010). Institutional goals are the

basis upon which the strategic partnerships are formed. As such, goals contribute to the motivations for partnerships. Eddy and Amey (2014) grouped the motivations for partnerships into four themes:

1. Economic goals associated with available funding, economic development, and shared resources,
2. Policy mandates driven by legislative initiatives,
3. Value alignment between the organizations' missions, visions, goals, and guiding principles, and
4. Strategic leadership based upon institutional priorities.

The second phase of the model includes formally establishing the partnership and building relationships. This stage of the partnership model encompasses the processes required to advance collaboration beyond the self-interest of the partners (Amey et al., 2010). The second phase typically begins with the formal process of developing a contract that, over time, evolves based on social processes involving the establishment of relationships and trust (Eddy & Amey, 2014).

The third phase of the model is partnership capital, in which the evolution of the partnership results in creating shared meaning, ongoing trust, and aligned strategic goals (Eddy & Amey, 2014). In this phase, the partnership becomes greater than the sum of its parts and becomes a recognizable meta-organization with inclusive norms, values, networks, synergies, and resources (Eddy & Amey, 2014). According to Eddy and Amey (2014), "strategic partnerships hold great promise and potential in their ability to result in system changes and new ways of addressing problems together" (p. 104). Therefore,

gaining a deeper understanding of the effective practices within P-TECH programs from industry partners offered the opportunity to produce knowledge beneficial to district leaders seeking to maximize the strategic partnerships of P-TECH programs.

Definitions

Specific terms were applied throughout this document. These terms were either unique to the P-TECH program or were used in a unique way for achieving the purpose of the study. The P-TECH related terms are defined in this section.

Industry partner. A company that has a signed MOU to partner with a school district to implement the P-TECH program. Industry partners play a direct role in addressing the skills gap by assuring that the P-TECH program delivers the requisite skills and experiences required through skills mapping and providing students with mentors and on-site learning experiences (Bishop-Josef et al., 2014).

Memorandum of understanding. An MOU is a partnership agreement between the high school, college and the industry partner that is a critical element of the P-TECH program. The written agreement between the public school district, the institution of higher education and industry partner should define the roles and responsibilities of each entity. The Texas Education Agency (2018) suggested the P-TECH partnership agreement should include, minimally, the following elements:

a. A detailed plan for work-based learning experiences for students appropriate to each grade level, such as facility visits, guest speakers, presentations, career information, job shadowing, internships, externships, and apprenticeships

b. Clear roles and responsibilities for worksite supervisors, mentors, teachers, support personnel, and other partners
c. Career mentoring with industry/business partner
d. Support for students' activities, such as clubs, Career and Technical Student Organizations, competitions, and special initiatives
e. Each MOU must include an agreement that the regional industry or business partner will give to a student who receives work based training or education from the partner under the P-TECH/ICIA program priority in interviewing for any jobs for which the student is qualified that are available on the student's completion of the program
f. Course path and program monitoring
g. The MOU should state clearly the industry certifications that will be acquired and the standards/curriculum that will be followed to achieve stated certifications
h. Student access to business and industry partners and work-based learning facilities, services, and resources
i. Transportation costs and fees. (p. 1)

Skills mapping. This term refers to the process of identifying vital skill and knowledge components of a job or role, in order to define what is required for the successful performance (Mittal et al., 2019).

Workplace learning. The workplace learning consists of coursework, mentoring, workplace visits and credit-bearing internships designed to help students develop the skills to transition into a career successfully (IBM, 2012).

Chapter 2: Literature Review

College and career readiness are rapidly supplanting high school completion as the key priority of the K-12 education system. Ensuring that students graduate from high school prepared to transition into college or career successfully is critical because the demand for skilled labor is increasing. Currently, there is a shortfall between the demand for and the supply of certain skills sets, creating a skills gap. The skills gap is the difference between the demand for certain skill levels and the supply of individuals who possess the required skills (Christo-Baker et al., 2017). The skills gap is a well-documented phenomenon that leaves millions of jobs unfilled in the U.S. For instance, at the U.S. Bureau of Labor Statistics, Richards and Terkanian (2013) projected that by 2022 the fastest growing occupations would be jobs that require a master's degree, and the second fastest growing occupations include jobs that require an associate's degree. Additionally, 63% of all jobs in the United States, and 90% of the jobs in growing industries, require postsecondary training (Sambolt & Blumenthal, 2013). More specifically, 11 of the 15 fastest growing occupations, between 2014 and 2024, required some level of postsecondary education (Hogan & Roberts, 2015). For example, Bishop-Josef et al. (2014) predicted that based upon labor trends in New York, approximately 350,000 jobs would go unfilled because employers are unable to locate workers qualified for middle skills jobs

The demand for skilled professionals is further compounded by the number of employees eligible for retirement along with advances in technology which require workers to obtain new or additional skill sets. In 2015 approximately 50% of the

technical professionals working in the oil and gas industry were eligible to retire (Behie & Henwood, 2018). Furthermore, the Global Agenda Council on Skills and Talent Mobility and the Steering Board (2011) reported the United States needed to add 23-million workers to the talent base by 2030 to sustain economic growth and noted "filing higher demand positions will require improved and more extensive vocational training" (p. 7). Sirkin et al. (2013) concluded the following in their report:

1) Companies are not doing enough to cultivate a new generation of skilled manufacturing workers in the United States. Manufacturers have scaled back training over the years, and they underutilize important high schools and community college resources to attract talent.
2) The retirement of aging workers and the heightened demand for workers could cause serious skilled-labor shortages.
3) Companies, schools, governments and nonprofits need to do much more in regarding to training and employing skilled manufacturing workers. (p. 4)

The demand for middle skill level professionals is high. Bishop-Josef et al. (2014) predicted that in New York alone 3.3-million total job vacancies between 2010 and 2020, would occur as a result of new jobs and openings from retirements and career switches.

The growing demand for skilled workers in science, technology, engineering and mathematics is well documented (Atkinson, 1990; Bishop-Josef et al., 2014; Behie & Henwood, 2018; Cappelli, 2015; Christo-Baker et al., 2017; Sirkin et al., 2013). The challenge to address the skills gap is further complicated by concerns regarding the adequacy of K-12 education to produce graduates prepared to enter into college or career.

Kirsch, Braun, Yamamoto, and Sum (2007) discussed the confluence of three powerful factors likely to have a major impact on the future of the country. They found the factors were divergent skill distributions, the changing economy, and demographic trends. Kirsch et al. concluded that a large percent of the adult population over 15 years of age do not demonstrate the needed literacy and numeracy skills to be successful in an increasingly competitive labor force nor the proficiency to be successful in postsecondary education. ACT (2007) also concluded the majority of 21st century American high school graduates, however, are neither academically prepared for the rigor of postsecondary education or of entering the workforce.

Nationally, approximately 56% of high school graduates are highly qualified for admission at four-year institutions of higher education (Chen, 2016). As a result of the significant number of high school graduates failing to be adequately prepared to enter freshman-level college courses, there is a high need for remediation (Alliance for Excellent Education, 2006). Approximately 28% of incoming college freshman enroll in at least one developmental course in reading, writing, or math (An, 2013). Developmental education courses are designed to ensure college students have met high school end of course standards and are comprised of prerequisite knowledge and skills for success in entry-level college classes (Chen, 2016). Most students who enroll in developmental courses, however, do not complete the sequence of required courses, which results in few students persisting to complete college-level math or English courses (Hodara & Jaggars, 2014). Therefore, a large percentage of students who enter college taking developmental

courses do not earn any degree. This lack of persistence negatively impacts these students' future earning potential.

The economic and long-term benefits of a college degree cannot be understated. High school graduates earn less than individuals who earn either a 2-year or 4-year college degree. Hershbein and Kearney (2014) found that the typical bachelor's degree holder earned about $1.2 million over a lifetime about $600,000 more than the average high school diploma holder and about $300,000 more than the average associate degree holder. Therefore, K-12 school leaders must implement strategies to ensure students graduate adequately prepared to meet the education needs projected by future workforce demands.

Research suggests that Early College High Schools (ECHS) are an effective strategy for improving the outcomes for high school students (Hoffman & Webb, 2010). Song and Zeiser (2019) conducted a longitudinal study of ECHS graduates which found that within 6 years after expected high school graduation, 84.2% of early college high school students enrolled in college, compared with 77.0% of control students. The American Institutes for Research (2014) concluded that ECHS students complete a postsecondary credential at higher rates than non-ECHS students in the study (see Figure 3). Within 6 years of high school graduation:

- More than 45% of ECHS students earned a postsecondary degree, compared to about 34% of traditional high school students
- About 29% of ECHS students earned an associate degree or certificate, compared to 11% of traditional high school students

- About 30% of ECHS students earned a bachelor's degree, compared to 25% of traditional high school students (Song & Zeiser, 2019).

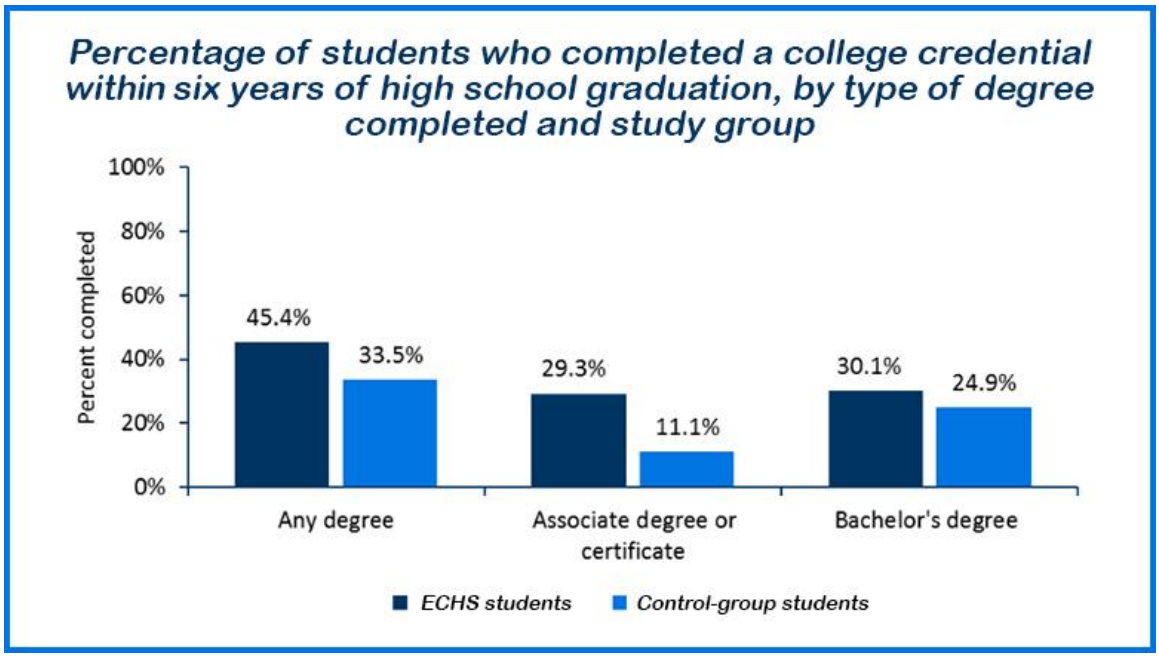


Figure 3. Comparison of ECHS and Tradition high school (control) group student outcomes as reported by the American Institutes for Research (2019).

Literature related to early college high schools has included several themes, among them are ECHS student populations (DiMaria, 2013), student success rates (Berger et al., 2010; Edmunds, 2012; Edmunds et al., 2017; Song & Zeiser, 2019) and the transition to four-year institutions (Haxton et al., 2016). The literature includes examinations of ECHS student outcomes compared to non-ECHS students (Berger et al., 2010; Edmunds et al., 2012, 2017; Haxton et al., 2016; Song & Zeiser, 2019). The literature has little discussion pertaining to ECHS programs designed to support workforce development or examination of P-TECH programs. Consequently, this review

attempts to synthesize literature toward filling the gaps in knowledge related to P-TECH schools as viable ECHSs whose primary focus involves workforce development.

This review of literature is comprised of three parts. Firstly, this review focuses on contextualizing economic impact with regard to high school and college degree attainment. Secondly, this study identifies and examines several strategies for increasing the number of students who graduate from high school both college and workforce ready. The assessment of the early college high school design and the more recent implementation of P-TECH model as a means to increase postsecondary completion and address workforce demands and middle skills gaps is included in the evaluation of the literature. Conclusions are drawn and the gap in the review is identified.

Education Attainment and Economic Impact

Equipping students with the knowledge and skills to graduate from high school adequately prepared for postsecondary success is essential. Education beyond high school is a prerequisite for a secure lifestyle and significantly improves the probabilities of employment and a stable career with a positive earnings trajectory (Ma et al., 2013). The benefits of college degree attainment are well documented and numerous (Ferraro, Schafer, & Wilkinson, 2016; Oreopoulos & Petronijevic, 2013; Oreopoulos & Salvanes, 2011; Perna, 2005). Individuals who earn college degrees tend to experience higher earnings, lower unemployment and poverty rates, and better working conditions; they also live longer and are generally in better health (Perna, 2005). For example, in 2015, the median annual income for workers with a bachelor's degree who were 22 to 27 years was $43,000; this value was approximately $18,000 higher per year than the earnings of

workers in the same age group with only a high school diploma (Miller et al., 2016). Additionally, nearly 8 out of 10 future job openings were predicted to require some workforce training or postsecondary education; therefore, high school graduates must obtain the requisite knowledge and skills to take advantage of future employment opportunities (Holzer & Lerman, 2009).

However, institutions of higher education and the business community are concerned about the inadequacy of a traditional PK-12 education in preparing students for the postsecondary education or training necessary to succeed in careers in the fastest growing industries (Balestreri, Sambolt, Duhon, Smerdon, & Harris, 2014). For instance, the 2015 National Assessment of Educational Progress (NAEP) reading assessment results indicated that 29% of 12th grade students scored below basic reading level, which means they did not have partial mastery of the appropriate grade level knowledge and skills (Waldman, 2016). When high school graduation and student achievement rates are disaggregated by ethnicity the numbers are even more alarming. Only 23% of African American and 20% of Hispanic students produce the skills needed to succeed in college (ACT, 2016). Furthermore, the ACT (2016) showed evidence of the significant achievement gaps that continue to exist among African American and Hispanic students when compared to White students as seen in Table 1.

Table 1

Percent of 2016 High School Graduates Meeting the ACT College Readiness Benchmarks by Race/Subject

Race/Ethnicity	English	Math	Reading	Science
African American	33	13	19	11
Hispanic	46	27	30	21
White	73	50	55	48
All Students	61	41	44	36

Given the importance of college education, it is imperative that PK-12 education systems implement practices that increase the number of students moving along a positive trajectory toward postsecondary completion. On average 80% of public high school students receive a regular high school diploma at the end of 4 years after starting ninth grade (Stetser & Stillwell, 2014). The national adjusted cohort graduation rate showed the percentage of public high school students who graduated with regular diplomas during 2014-2015 school year and within 4 years was 83% (McFarland et al., 2017). Approximately 60% to 70% of high school graduates attempted some form of postsecondary education (Bureau of Labor Statistics, 2018); however, these students enroll in developmental education courses at colleges and universities at alarming rates (Southern Regional Education Board [SREB], 2010), suggesting a significant number of high school graduates do not possess the requisite knowledge for college-level work. College professors have estimated that 42% of students are not adequately prepared for college, and 70% of college instructors report having to devote some of their first-year

class time toward reviewing content that they feel should have been taught in high school (Wyatt et al., 2011). Only 28% of college instructors believe that public high schools adequately prepare students for the challenges of college (Wyatt et al., 2011).

College degree attainment is essential because individuals with higher levels of education earn more and are more likely to be employed which benefits both the individual and society. However, just over half of the students who start college finish it within 6 years (Shapiro et al., 2015). College graduates obtain greater financial gain than high school graduates with no postsecondary success. For example, the median income of bachelor's degree recipients with no advanced degree working full time in 2011 were $21,100 more than the median earnings of high school graduates (Ma, Pender, & Welch, 2016). Importantly, society benefits when more of its population complete higher education degrees. Perna and Riepe (2015) found when college attainment levels improve, the tax base increases, reliance on social welfare programs declines, and civic and political engagement increases.

However, Jobs for the Future (2014) found the number of off-track youths to be staggering because 17% of Americans between the ages of 16 and 24 years, or approximately 6-million young people in the United States, are out of school and out of work. The disconnection from school and work has an enormous negative impact on the nation. The estimated lifetime economic consequence of a single off-track 20-year-old is $235,680, and the total fiscal and social burden of total number of off-track youth is calculated to be $6.1 trillion over the span of their lifetimes. Additionally, Jobs for the Future estimated that millions of jobs remain unfilled each year due to lack of available

and qualified candidates and projected there was a shortage of 12 million skilled workers in 2025. The number of off-track youth in conjunction with the number of jobs that remain unfilled each year suggested new and innovative approaches were required to improve education outcomes and create pathways that prepare students for jobs that would lead to productive careers (Jobs for the Future, 2014).

Strategies to Increase College and Career Readiness

School districts implement a variety of practices to help prepare students for the transition into post-secondary education or careers. Through endorsements Texas HB5 requires specialized coursework to help prepare students for life after high school. The law requires students to select an endorsement category to add to their Foundations High School Program prior to entering high school. Students also have access to advanced learning opportunities such as dual credit and advanced placement courses to support college and career readiness (Required coursework, §19 TAC chapter 74, subchapter G.; Graduation requirements, §19 TAC chapter 74, subchapter B.) High school students who participate in college-credit-bearing coursework are more likely to graduate high school, go to college, and earn a college degree (Haxton et al., 2016). The three most common advanced academic practices implemented in high schools are International Baccalaureate (IB), Advanced Placement (AP), and dual enrollment programs, all of which are designed to allow students to earn college credit while in high school.

AP programs offer rigorous courses and exams through which high school students may earn college credit (Barnard-Brak, McGaha-Garnett, & Burley, 2011; Blankenberger, Lichtenberger, & Witt, 2017). Most students enroll in standardized AP

courses taught by high school teachers who have been certified by the AP sponsor, the College Board (2018). The College Board offers exams for 37 advanced-level courses in 22 subject areas including calculus, physics, European history, and foreign languages. AP course enrollment is typically free for the student because it is offered in the high school; however, taking the AP exam to earn college credit requires test takes to pay the exam fee of $83. AP exams are graded on a scale of 1 to 5. A score of 3 is considered passing by most school systems. However, many higher education institutions accept only AP exam scores of 4 or 5 for college credit (Warne et al., 2015). Also, although a community college may accept AP credits, a university may refuse to accept those same credits when the student enrolls in a baccalaureate program as a first time in college student or transfers from a community college into a baccalaureate program. Moreover, some universities and colleges use AP grades as placement tools but do not award college credits (Warne et al., 2015).

The IB program is offered in more than 100 countries that offers rigorous liberal arts and classical curriculum as created and administered by the International Baccalaureate Organization (IBO). The IB Diploma program is designed for students aged 16 to 19 years. Although an IB Diploma is awarded to those students completing all exams, high schools may offer students the option of taking only select IB courses without earning an IB diploma. All program instructors must be trained and certified by the IBO. As with the AP program, IB courses prepare students for the internationally normed exams that were developed by IBO and are graded by IBO on a scale of 1 to 7.

Scores of 4 or higher generally lead to college credit, although postsecondary institutions set their own policies on credit awards, just as they do with AP scores (IBO, 2016).

Dual credit, sometimes called concurrent enrollment, permit high school students to earn transferable college credits before graduation (Karp et al., 2008). The coursework may count as credit toward both high school and college graduation. These college credit bearing courses may be taught at high school or college campuses by either high school teachers or college faculty. High school students can enroll in dual credit courses as cohorts forming learning communities; but they can also choose to take individual courses as they choose. However dual credit course admission requirements are set by the colleges offering the dual credit opportunity.

Dual credit coursework must satisfy the learning goals and objectives of both educational entities. The dual credit courses' learning objectives must be consistent in terms of rigor, performance expectations, behavior expectations, and pedagogy so that all students attending these courses gain comparable learning experiences. During the 2010-2011 academic year, the National Center for Educational Statistics (NCES, 2013) reported that over 1-million high school students had taken at least one dual credit course within their junior or senior year and over 2-million dual credit courses completed nationwide. Dual enrollment programs are present in all 50 states, and 40 states have state-level policies that address dual enrollment (Karp et al., 2008).

Early college high schools are another type of dual enrollment program designed to help increase post-secondary degree attainment. Zinth (2016) of the Education Commission of the States suggested early college high schools help meet workforce

needs and increase both high school graduation and college participation rates among presently underserved student populations. Early college high schools are small schools from which students leave with not only a high school diploma but also an associate's degree or two years of college credits (Kaniuka & Vickers, 2010). By changing the structure of the high school years to include the completion of a significant number of college credit hours, early college high schools have the potential to improve both high school and college graduation rates and to better prepare students for entry into high-skill careers (Lieberman, 2004).

Traditional early college high school (ECHS) programs were created to ease students' academic transition from high school to college. ECHSs combine secondary and postsecondary curricula, environments, and pedagogical practices to in order to remove the financial, academic, and psychological hurdles that prevent students from pursuing and/or completing postsecondary studies (Early College High School Initiative, 2008). The ECHS model incorporates both high school and college experiences to increase the number of students who graduate from high school and enroll and succeed in postsecondary education (Edmunds, 2012; Thompson, & Ongaga, 2011). Conversely, pathways in technology early college high (P-TECH) schools represent an innovative ECHS spanning Grades 9 to 14 that bring together the best elements of high school, college, and career education. P-TECH schools are a form of the ECHS that not only prepare students for postsecondary study, but also support economic development by preparing students to enter the workforce. P-TECH programs are charged with addressing workforce demands by training students for middle skills jobs that require an associate

degree or technical certificate. According to IBM (2012), 14-million jobs requiring middle skills were projected to be created in 2018 and the highest paid of those jobs was expected to be in science, technology, engineering, and mathematics (STEM). As such, the ECHS model requires partnership between the high school and college. Comparatively, the P-TECH model requires partnership between the high school, college and industry partners.

The Evolution of Early College High School Programs

The ECHS concept was first introduced by educator Leonard Koos during the 1930s and 1940s as a model to integrate secondary and post-secondary education (Kisker, 2006; Koos, 1946). Known as the *6-4-4 plan*, the purpose was to increase college enrollment and save public school systems and colleges money and resources (Kisker, 2006; Koos, 1946; Peralez, 2014). The 6-4-4 plan was adopted by several states, including California, Kansas, Oklahoma, Missouri, and Mississippi. The program design consisted of Grade 7 through 10 students completing high school and rising Grade 11 students enrolling in college courses at their local community colleges (Kisker, 2006; Peralez, 2014). Koos (1946) asserted that the goal of the 6-4-4 plan was to connect the last 2 years of high school to the first 2 years of college because the high school curriculum and the freshman and sophomore college curriculum were inherently repetitive. However, due to lack of funding and changing regulations for both secondary and post-secondary institutions, the 6-4-4 plan faded from the nation's education landscape after World War II due to its nontraditional program design (Karp & Hughes, 2008; Kisker, 2006; Peralez, 2014). Variations of the plan re-emerged during the 1970s

and served as a foundation for the establishment of the Middle College High School (MCHS) as a combined high school and postsecondary education experience.

Middle College High Schools

An MCHS is located on a community college campus at which students take high school courses then matriculate seamlessly into their postsecondary coursework. The MCHS design differed from the 6-4-4 model in that the MCHS purpose was to enable low income, urban students of color access to higher education. The original MCHS was founded by Janet Lieberman (1986, 2004) at LaGuardia College in New York, and Lieberman believed that the model could prohibit students from dropping out of high school. MCHS focused on students between the ages of 16 and 20 years to change their ideas regarding the benefits of attaining an education (Carter, 2004; Karp, Calcagno, Hughes, Jeong, & Bailey, 2007; Lieberman, 1986). The MCHS framework was based upon implementing a flexible curriculum that would permit students to advance at their own pace, and according Wechsler (2001), consisted of the following:

- after demonstrating college readiness, students would have the opportunity to enroll in college courses;
- a cooperative educational program that included field trips, internships, and apprenticeships; and
- a counseling structure that would encourage a student to engage and build faculty relationships, cooperative learning, student visibility, and individuality. (p. 167)

Despite initial challenges to integrate high school and college completion, MCHS demonstrated evidence of meeting the needs of the at-risk students (Lieberman, 2004). Data were compiled from the New York area's LaGuardia MCHS students to the non-MCHS students in the same geographic area, and the data showed the successes of MCHS students in student attendance, graduation rates, and college readiness. The results illustrated are in Table 2.

Table 2

Comparison of Outcomes: MCHS Students vs. Non-MCHS Students as Reported by Pollock (2009)

Outcome	MCHS %	Non-MCHS %
Attendance	81.0	69.0
Graduation	87.8	86.4
Dropout Rate	5.8	40.0
College Readiness		
Reading	98.2	77.0
Math	49.5	47.0

In further study, Cullen (1991) reported that MCHS students perceived the program as collaborative and student-centered and that the faculty was interested in their development as learners, which motivated the students to seek success. Students indicated that through this new motivation they felt enriched by the curriculum. Also, the collaborative efforts of instructors and administrators enabled students to perceive

everyone around them as actively involved in their self-development, both academically and personally (Cullen, 1991).

Throughout the following decade, the number of MCHS programs grew from one institution to 20 across the country. Sustainable funding for MCHS programs and their documented benefits have equipped MCHSs to continue, unlike the 6-4-4 plan that was not sustained following WWII. The successes of the MCHS design served as the framework for establishing the ECHS blueprint.

Early College High Schools

The ECHS design differs from the MCHS framework in that ECHSs seek to enroll students who are historically underrepresented in postsecondary education. The target student population for ECHSs are students who are the first in their family to go to college and students who are low-income or members of a minority group underrepresented in college (American Institutes for Research [AIR], 2014). The first ECHS was Bard Early College High School, which opened in 2001, formed through a partnership between Bard College and the New York City Public Schools (Berger et al., 2010). The Bill & Melinda Gates Foundation, along with Carnegie Corporation of New York, the Ford Foundation, and the W.K. Kellogg Foundation, provided funding for the Early College High School Initiative (ECHSI, 2010; Lieberman, 2004).

The ECHSI was established in 2002 to create or redesign 150 early college high schools for underserved low-income young students in targeted neighborhoods within five years. ECHSs embodied the distinguishing features of the seminal MCHS design in addition to incorporating structural interventions based on the pragmatic student

experiences that occurred in the MCHS program (Lieberman, 2004). ECHSs, like MCHS, are small schools located on or near a college campus and are intended to increase the number of students who graduate from high school prepared to successful transition into postsecondary education. By design the ECHS model required intensive collaboration between secondary and higher education partners. High school and postsecondary partners developed ECHS articulation agreements that included guided pathways. The guided pathways mapped out the course sequence that allowed students to graduate from high school in 4 to 5 years while simultaneously earning 2 years of transferable college credit (DiMaria, 2013). This ECHS blueprint (as summarized here) consists of adhering to the following five core principles:

1. Serving students underrepresented in higher education,
2. Operating within a local education agency, a higher education institution, and the community, all of whom share jointly accountable for student success,
3. Partnering with higher education partners and the community to jointly develop an integrated academic program, so all students earn 30 to 60 hours of transferable college credit that will lead to 4-year college degree attainment,
4. Engaging students in a comprehensive support system that develops academic and social skills as well as the behaviors and conditions necessary for college completion,

5. Working with higher education and community partners and intermediaries to advance the early college movement through policy development and sustainability (Early College High School Initiative, 2008; TEA, 2017).

Therefore, ECHS students earn college credit at no cost and receive assistance when completing college and financial aid applications in order to reduce their barriers to postsecondary access and 4-year institution enrollment (Hoffman, & Vargas, 2010). ECHS personnel provide supportive and nuturing learning environments that bridge high school and college experiences to ensure students are capable of earning college credit, workforce credentials, or an associate's degree (AIR, 2014; Valadez et al., 2012). The ECHSI goal was achieved as the establishment of 280 ECHSs to serve over 80,000 students annually in 25 states (Jobs for the Future, 2014). Furthermore, Jobs for the Future (2014) reported that of the 80,000 students who participated in ECHS programs, 73% were students of color and 60% received free or reduced lunch. Therefore, the majority of the students enrolled in ECHS programs represented the targeted student population that is less likely to attain postsecondary education credits.

Additionally, ECHS students have higher high school graduation, college credit attainment and a higher rate of postsecondary matriculation (Berger et al., 2014; Edmunds et al., 2015). Jobs for the Future (2011) reported on 10 years of national ECHS outcome data and found ECHS students had a 90% national high school graduation rate over their non-ECHS peers who had a 78% national high school graduation rate. These positive ECHS outcomes paved the way for the development of Pathways to Technology

Early College High Schools (P-TECH), a new innovative ECHS program focused on workforce development.

Pathways to Technology Early College High School Model

In 2011, Symonds, Schwartz, and Ferguson discussed the need for K-12 education to focus on career development, expanded partnerships with postsecondary institutions, and collaborate with industry professionals to address skills gaps. Grand (2017) defined as the skills gap as occurring between the skills employers need and the skills of the available job candidates. Symonds et al. noted that many high-demand, high-wage careers in fast-growing industries do not require a bachelor's degree and are accessible by obtaining postsecondary certificates and credentials in technical career areas such as information technology, health care, and advanced manufacturing. However, 500,000 technology jobs remain vacant each year, creating lost revenue for companies across many industries (Gale, 2018).

The demand for STEM jobs is growing at a faster rate than general job growth across industries, and simultaneously the skills demanded by STEM employers have evolved much faster than the STEM curriculum used by school systems. Thus, the skills gap is a daily reality affecting the national economy (Grand, 2017). Furthermore, economists predict that the United States' skills gap could endanger the nation's economic growth since students are not prepared for college and are unable to access high-demand, high-wage career fields' employment opportunities (Kochan et al., 2012). Symonds et al. (2011) noted that solutions to address the skills gap involve developing

programs to accelerate high school students' skills development through earning postsecondary STEM certificates and credentials.

P-TECHs blend academic learning with workplace skill development and provide students with a clear pathway from high school to college to career (Hinojosa & Crozier, 2018). The P-TECH program pioneered by IBM was created to address the growing demand for talent to fill middle skills STEM positions (Gale, 2018). Built upon the ECHS design, the P-TECH program requires a three-way partnership between the high school, local college, and at least one local industry. P-TECHs are early colleges designed to provide students with the opportunity to graduate with both a high school diploma and an associate degree at no cost to the student or their families. However, P-TECHs differ from an ECHS because they offer added component of providing students with the opportunity for first priority interviews to gain entry-level employment with the business and industry partners affiliated with the school (Abdul-Alim, 2017).

While the ECHS framework leads to high school graduate with college credits or an associate degree at the end of Grade 12, the P-TECH design is inclusive of Grades 9 through 14, such that Grades 13 and 14, representing the first 2 years of college, have a specific focus on building skills through career and technical education. P-TECH programs are designed to provide students with the following: (a) engagement with industry speakers, (b) workplace learning and internships, (c) mentoring by career-matched professionals, (d) opportunities to visit worksites, (e) academic support and mentoring by high school level and college faculty, (f) the Associate of Applied Science degree for working in a STEM field, and (g) priority interviewing opportunities for jobs

offer by P-TECH business partners (Hinojosa & Crozier, 2018). Because of these features of P-TECH, P-TECH programs have grown to serve over 20,000 students at 90 schools within seven states in addition to schools located in Australia and Morocco in less than 10 years of existence (Mathewson, 2018). P-TECH is a new education model that was co-developed by IBM working collaboratively with educators, policymakers and elected officials. P-TECH was designed to be widely replicable and sustainable, as part of a national effort to reform career and technical education (P-TECH, 2019). Figure 4 provides a visual contrast between the ECHS and P-TECH models as applied by the TEA (2019).

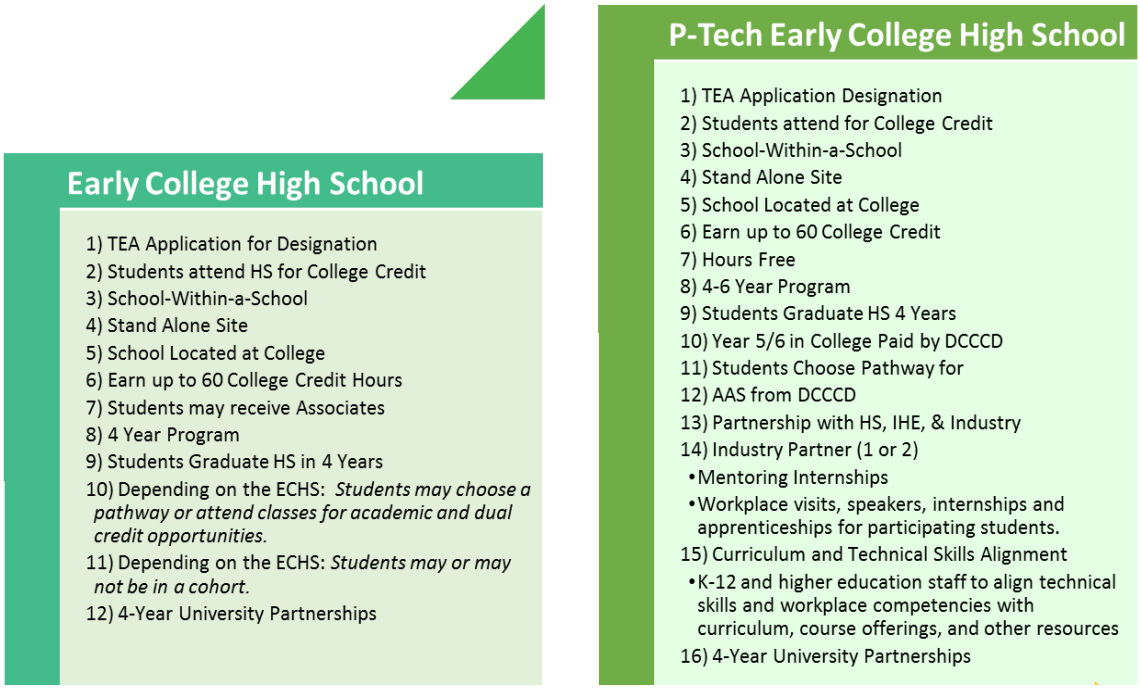


Figure 4. The TEA's (2019) distinctions between ECHS and P-TECH.

Texas P-TECH Designation and Graduation Requirements

In the state of Texas, a school district or open-enrollment charter school may apply to the TEA for designation as a P-TECH school. The designation was created by TEA to ensure that districts and schools operating as P-TECH campuses maintain the integrity of the model. In June of 2018, the TEA implemented the Pathways in Technology Early College High Schools Design Blueprint. To obtain P-TECH designation schools must provide information that documents adherence to the benchmarks outlined in the TEA P-TECH Design Blueprint. The six benchmarks are:

1. School Design: The P-TECH program must offer open enrollment and flexible scheduling structures that enable students to combine high school, postsecondary courses and work-based learning, at no cost to participating students.
2. Target Population: The P-TECH program shall serve, or include plans to scale up to serve, students in Grades 9 through 14, and shall target and enroll students who are at risk of dropping out of school as defined by the Public Education Information Management System (PEIMS) and who might not otherwise go to college.
3. Strategic Alliances: Strategic partnerships with business and industry partners and institutions of higher education (IHE) are formally articulated in writing and clearly define a variety of careers.
4. Curriculum, Instruction, and Assessment: The P-TECH program shall provide a rigorous course of study that enables a participating student to receive a high

school diploma, an associate degree, postsecondary certificate provided by an IHE, or industry certification during Grades 9-14.

5. Work-Based Learning: The P-TECH program must offer students a variety of relevant, high-skill work-based learning experiences at every grade level that respond to student interest and regional employer needs and contribute to students earning aligned industry certifications and credentials.
6. Student Support: P-TECH will provide wrap-around strategies and services involving multiple stakeholders to strengthen both the academic and technical skills necessary for high school and college readiness, as well as provide academic, technical, and individual support for students to be successful in rigorous academic and work-based learning experiences (TEA, 2018).

Students enrolled in P-TECH programs in Texas have the option to remain enrolled in high school for 2 additional years and generate funding based upon average daily attendance if they have not completed courses required for high school graduation. Students enrolled in P-TECH programs must as a minimum complete the basic Foundation High School Program (FHSP). However, due to the innovative design of the P-TECH program students will most likely earn distinguished achievement and Performance Acknowledgement. To earn distinguished achievement students must complete 26 credits inclusive of four credits of math including Algebra II, four credits of science, all FHSP curriculum requirements and earn an endorsement. P-TECH students earning an Associate degree, completing 12 hours of college academic courses or earning a nationally or internationally recognized business or industry certification may also earn

a performance acknowledgement on their high school diploma and transcript (Required coursework, §19 TAC chapter 74, subchapter G.; Graduation requirements, §19 TAC chapter 74, subchapter B.)

ISD P-TECH Program

The urban school district had 18 (28%) of the 64 TEA designated P-TECH programs (TEA, 2018). The local community college district served as the institution of higher education and 77 industry partners support the urban school district's P-TECH program. The school district's P-TECH program was implemented at scale to increase the number of school district graduates earning postsecondary degrees and credentials. The urban school district's P-TECH program launched in eight high schools with the lowest 6-year college graduation rates, the first class of ninth graders enrolled in August 2016. The P-TECH were designed as schools within a school. P-TECH students attend Grade 9 and 10 core curriculum classes in a dedicated portion of the building at their high school campus. In Grade 11, students are transported to campus of their partner community college where they will continue their studies until graduation.

The urban school district's P-TECH pathways include coursework which leads to attainment of an associate of applied science degree. Students in the P-TECH program will complete a personal graduation plan based upon a coherent, articulated sequence of rigorous academic and career/technical courses, commencing in the ninth grade and leading to an associate degree which includes an industry-recognized certificate awarded through completion of dual credit coursework. The urban school district's P-TECH students have the opportunity to earn the distinguished achievement high school diploma,

endorsements in STEM and business and industry while completing college level coursework in areas of study such as construction, computer programming, information technology, software design, health care, accounting and business administration.

School and Business Partnerships

P-TECH programs are not the first high school-based programs to partner with business and industry in order to provide students with work-based learning experiences or designed to increase the number of students exposed to careers in STEM. Programs consisting of partnerships between high schools, higher education institutions, community organizations and industry to provide authentic learning experiences in STEM began to emerge in the early 1990's (Camasso et al., 2019). In 1994, President Clinton's administration enacted the School-to-Work Opportunities Act (STWOA) as a joint initiative between the Departments of Education and Labor. STWOA programs had three primary components:

1. School-based learning, which included a coherent multiyear sequence of integrated academic and vocational instruction and at least two years of secondary education and one or two years of postsecondary education which tied to occupational skill standards and challenging academic standards;
2. Work-based learning, which provided students with workplace mentoring and a planned program of work experience linked to schooling; and
3. Connecting activities, designed to coordinate work and school-based learning components by involving employers in order to improve secondary-postsecondary linkages, and to provide technical assistance. (p. 1)

Through STWOA every state had access to seed money to design a comprehensive school-to-work transition system. States completing the application received one-time 5-year grants to implement school-to-work systems that integrated academic and vocational education, linked secondary and postsecondary education, provided students with learning opportunities at work sites, and fully engaged the private sector in the process (Hershey, Silverberg, Haimson, Hudis, & Jackson, 1999).

The STWOA paved the way for implementation of career academy high schools. Career academies are innovative high schools which consist of small learning communities that focus on career-related themes, such as health, business, and information technology serving approximately 200 students in Grades 9 through 12 (Lanford & Maruco, 2017). Career academies were designed to increase student engagement and to improve students' performance in high school while simultaneously exposing students to options for college and career (Hemelt et al., 2018). Most career academies partner with local businesses to provide students with work-based learning opportunities (Camasso et al., 2019). According to Lanford and Maruco (2017), "a fundamental component of career academies involves the connection of classroom learning with valuable industry-related experiences, including an internship, field trips, and/or guest lectures" (p. 628). Most career academies utilize the school within a school framework and are multi-year programs that integrate career and technical education (CTE) courses, project-based learning, internships, and other activities organized around specific career themes (Hemelt et al., 2018).

One such example is National Academy Foundation (NAF) academies. NAF was founded by Sanford I. Weill, Chairman Emeritus of Citigroup, Inc., and created as a partnership between business leaders and educators to address the need to prepare students for professional careers. NAF was established as a central organization to support quality expansion of academies of finance and tourism (Orr et al., 2004). In 2016-2017, 96,741 students were served in the NAF's 675 academies and received career-themed curriculum, and these academies incorporated work-based learning and were supported by an advisory board of business and community leaders (Sun & Spinney, 2017). While the NAF Academies and P-TECH model have the same fundamental purpose to engage industry professionals in preparing students to enter the workforce, P-TECH differs in that P-TECH industry partners agree to provide students with "first-in-line" interview opportunities. P-TECH essentially represents a form of the career academy.

College and Career Readiness Program Outcomes

Kemple and Willner (2008) conducted a study to analyze the long-term impact of career academies. They made four key findings:

1. Career Academies provided a viable pathway to postsecondary education; however, they did not create better opportunities than those offered in the regular high school environment.
2. Career Academies offered essentially the same set of academic courses and course requirements as those offered in the rest of the high school.

3. Academies may have produced substantial increases in vocational and career-related course-taking that were accompanied by a reduction in academic course-taking.
4. Career Academy programs may exhibit small or negligible impacts on labor market outcomes.

Additionally, AP courses provide high school students with the opportunity to receive college credit following completion of an AP course by taking an end-of-year comprehensive examination. Researchers have found that students who take AP exams typically earn a bachelor's degree, and subsequently, they earn higher incomes than nonAP course-taking students (Warne et al., 2015). The number of students enrolled in AP courses has increased dramatically with the number of students taking AP examinations growning from 884,741 in 2000 to 2,808,990 in 2018 (College Board, 2018). Although the number of students taking AP exams has increased, Hispanic and African American students are underrepresented in AP courses nationwide, and if these student complete the AP examinations, they typically score significantly lower than White students (Ohrt, Lambie, & Ieva, 2009).

Likewise, the number of students participating in IB programs has grown and a significant number of students enrolled in IB programs attend postsecondary institutions. Nevertheless, IB program participants are not majoring in STEM fields which does not help to alleviate the challenge pertaining to the growing demand for STEM professionals. In an analysis of 15,680 IB diploma students graduating high school in 2008 and enrolling in postsecondary institutions by May 2014 from 830 high schools as the United

States, Bergeron (2015) found immediate postsecondary enrollment for all IB diploma students was 78% compared to the national average of 69%. Bergeron identified that a vast majority of IB program participants attending postsecondary institutions majored in psychology and only a small number of these students elected to major in a STEM field. While, AP and IB programs provide students with access to challenging curriculum and college-level coursework in high school, these programs show a disparity, or an achievement gap, between the number of White students enrolling in AP course or IB program compared to the number of African American and Hispanic students. Black and Hispanic high school students enroll in AP and IB courses at approximately half the rate of white students (Adams, 2013; Klopfenstein, 2010).

There are limited studies regarding student outcomes pertaining to Texas House Bill 5. The FHSP went into effect at the start of the 2014-2015 school year and the first cohort of students graduated in the spring of 2018 (Latham-Sikes, 2018). Students graduating in 2015, 2016 and 2017 had option to graduate based upon FHSP requirements. The House Bill 5 Evaluation Report (Mellor et.al, 2015) found that students who opted to graduate on the FHSP had a higher probability of enrolling in a Texas two-year college. The report also indicated the results should be interpreted with caution as students from those cohorts who opted into the FHSP may not be comparable to later cohorts who are required graduate under the Foundation High School Program (Mellor et.al, 2015).

Conversely, dual enrollment programs inclusive of ECHS have shown a positive relationship between dual enrollment and postsecondary outcomes for students who are

traditionally underrepresented in college (Giani, Alexander, & Reyes, 2014; Hoffman, Vargas, & Santos, 2009). Haxton et al. (2016) found early college students were more likely to earn a bachelor's degree within 4 years after completing high school, but the percentages of students earning associate's degrees in 4 years was statistically indistinguishable between ECHS students and students within the traditional high school control group. ECHS programs were designed to make college accessible and affordable by bridging the gap between the high school and the college for students from ethnic backgrounds which are historically underrepresented in higher education (Jobs for the Future, 2014). ECHSs are designed to provide a smooth transition from high school to college for students who are tradtionally underrepresented in higher education. Although the research regarding ECHS students' postsecondary graduation and employment status is limited, researchers have found that ECHSs do have a positive impact on postsecondary enrollment (Edmunds, Willse, Arshavsky, & Dallas, 2013; Howley et al., 2013; Miller et al., 2013).

Conclusion to the Literature Review

The challenge to prepare all students to transition to college or a career successfully is a pressing issue for K-12 educational systems within the United States (Bragg & Taylor, 2014). Therefore, K-12 education systems strive to implement strategies and programs to help ensure that students graduate prepared to enter into college or a career. AP, IB, dual enrollment, and early college programs have served to provide students with access to rigorous curriculum in order to assist with the transition in postsecondary education (Karp, 2012). Nevertheless, these programs are not

designed to address the middle skills gap caused by the high demand for professionals in middle skill level jobs that require an associate degree or technical certificate in STEM fields.

Career Academies were instituted to help address the growing demand for STEM professionals. Career Academies operate as schools within a school and provide career and technical education coursework along with workplace learning experiences. However, in the longitudinal study conducted by Kemple and Wellner (2008), Career Academies had small or negligible impacts on labor market outcomes. Furthermore, the vast majority of the literature regarding early college high school focused on the student population and transition into postsecondary institutions (Berger et al., 2010; Edmunds, 2012; Edmunds et al., 2017; Haxton et al., 2016). Consequently, limited research has been conducted regarding ECHS graduates' workforce development or on their preparation for careers in STEM fields. With the emerging P-TECH programs designed to increase the number of students graduating with a STEM associate's degree or other postsecondary credential, educators and policymakers need information and research to be available regarding program outcomes and impact, such as information about the effectiveness of P-TECH programs during their rapid expansion. Grand (2017) shared the need for research as related to the following:

> Before the first P-TECH school in Brooklyn had even graduated its first class, the P-TECH model had already expanded to 100 schools across the US. Critics argue that the program's rapid expansion is not justified by results, nor have educators had enough time to ensure the education model's sustainability. (p. 5)

As a solution to the lack of outcome-oriented and effectiveness data, Abdul-Alim (2017) recommended tracking P-TECH graduates longitudinally through the first year after graduating to determine if the P-TECH experience makes a meaningful difference in terms of students' salaries. The P-TECH concept was created as a solution to the growing economic crisis and lack of a skilled workforce in major growth industries such as information technology and advanced manufacturing. Additionally, the business and educational partnership is a potential catalyst to changing the economy and reducing poverty. P-TECH combines academic rigor with career focus, where graduates earn a high school diploma and a no-cost, industry-recognized associate's degree, and become the first in line for jobs with the employer partner. The P-TECH program is an innovative and revolutionary educational model with limited outcome data as it relates to student achievement and industry partner perspectives and goals.

Chapter 3: Methodology

The purpose of the qualitative study was to obtain insight regarding industry partners' experiences and perceptions related to P-TECH program and its impact on student readiness to enter the workforce as middle skill level STEM professionals. Included within this chapter are purpose of the study, details of the research design, data collection procedures and data analysis.

Purpose and Research Questions

Educators must embrace their roles as partners with employers in order to help students successfully enter into the workforce. As the need for STEM professionals becomes greater, the need for organizational change related to effective partnerships with industry professionals is needed. As one solution, P-TECH programs are formed based upon a partnership between high school, college and industry partners. The P-TECH design allows K-12 educational systems and institutions of higher education to gain a deeper understanding of the evolving needs of employers (IBM,2012).

The purpose of the qualitative study was to examine the experiences of six P-TECH industry partners supporting a large urban school district in Texas and their perceptions regarding the impact of the P-TECH program in preparing students to enter the workforce. The researcher investigated industry partners' experiences of engaging with the urban school district and area community colleges as part of implementing P-TECH programs that prepared students to enter into the workforce as middle skill level STEM professionals. The urban school district had 18 TEA designated P-TECH programs and recruited 77 industry partners to support P-TECH programs throughout this

large district. Industry partners from a representative sample of the P-TECH partners were interviewed about their lived experiences implementing the P-TECH program. This study answered the following research questions:

1. What are industry partners' perceptions of how the P-TECH program prepares students to enter into STEM related careers?
2. What are industry partners' perceptions of how the school district engages business and industry in developing career pathways which align with Texas HB5 requirements?
3. What do industry partners perceive as successes and challenges associated with the P-TECH program?

Research Design

The study was qualitative in order to give voice to the industry partners who have experienced the phenomena of representing industry within a P-TECH program firsthand. The research methodology provided an opportunity to understand industry partners' experiences within the P-TECH program (Moustakas, 1994). Studying P-TECH industry partners using qualitative research methods provided an opportunity to give account of the lived experiences of P-TECH industry partners (Van Manen, 2007). This understanding would be important to gaining a deeper understanding of industry partners' experiences and perspectives and to assist superintendents in identifying best practices related to implementation of P-TECH programs or engaging industry in order to prepare graduates to transition into the workforce.

Qualitative research begins with acknowledging that there is a need to understand a phenomenon from the point of view of the lived experience in order to discover the meaning of it (Englander, 2012). The phenomenon shared by all of the participants is that they were P-TECH program industry partners. All of the participants were P-TECH program industry partners associated with this urban school district for at least one full year. Given that the P-TECH program was rapidly expanding, there was a need to understand the P-TECH phenomenon from the perspective of industry partners since the primary focus was to prepare students to transition into the workforce successfully.

According to Williams (2007), the primary objective of a qualitative study is to understand the experience from the participants' point of view. A qualitative study makes the most sense with this type of research "to determine what an experience means for the persons who have had the experience" (Moustakas, 1994, p. 13). Qualitative study allows for describing the meaning provided by several individuals who shared the experience of a phenomenon, in this case the P-TECH industry partner phenomenon (Creswell, 2007). Qualitative analysis effectively brings to the fore the experiences and perceptions of individuals from their own perspectives which can then be used as the basis for practical theory in order to inform, support or challenge policy or action (Lester, 1999). This methodology provides the best opportunity to develop a rich description of the in-depth perceptions of P-TECH program industry partners (Creswell, 2013).

Participants

Participants were selected through purposeful sampling. Purposeful sampling is used in qualitative research to in order to identify and select participants that are

knowledgeable about or have experienced the phenomenon being investigated (Palinkas et al., 2013). For the purpose of this study, four to six companies identified as P-TECH program industry partners at the urban school district for schools that received P-TECH designation from the TEA were sought for participation. To obtain P-TECH designation from TEA schools submit an application and artifacts to demonstrate development of the P-TECH program according to the TEA P-TECH benchmarks. The TEA P-TECH benchmarks are common among schools; however, the degree of implementation of program components may vary among campuses. Participants were selected who meet the following criteria:

1. The participants are currently serving as a P-TECH industry partner at a high school designated as a P-TECH by TEA.
2. The participants have served as a P-TECH Industry Partner and are within their partnerships' second year or have served as such for 2 or more years.
3. The participants have signed the P-TECH industry partner MOU or are in the process of signing a P-TECH industry partner MOU.

The purpose of participants serving 2 or more years as an industry partner was to capture information regarding the industry-employer side of the program as students' matriculate through the curriculum from the perspective of industry partners. My guiding assumption was that companies' representatives serving 2 or more years as industry partners would be interested in potentially interviewing P-TECH program graduates for positions within their companies.

The six interview participants in this study served as the industry partner liaison with the partnering high school and college. In serving as the industry partner liaison, each participant was responsible for the engagement, operation, and sustainment of their company's partnership within the P-TECH program. In this role, the participants were intricately involved in development of the partnership and described their experiences in rich, thick, qualitative detail in their interview responses. There were two chief executive officers, two executives responsible for corporate citizenship, a senior manager responsible for technology and software development, and a program manager as shown in Table 3.

Table 3

Participants' Pseudonyms and Positions in Their Companies

Participant	Pseudonym	Position Title
1	Angela	Chief Executive Officer
2	Brenda	Vice President of Human Resources
3	Charles	Chief Executive Officer
4	Dawn	Project Manager
5	Edna	Local Market Lead
6	Frank	Senior Manager

Due to the participants' direct connections to the P-TECH partnerships and to honor the ethical responsibility to protect the anonymity of the six interview participants as outlined by the University of Texas IRB Approvals, the participants' profiles are not

described in further detail. This limited level of profile description fulfilled the assurance to the participants of the protection of their identities, allowed them to share information freely in their responses, and facilitated authentic data collection. Excerpts from their responses are included to support the presentation of the study's findings that follow.

Data Collection and Procedures

Participants were identified as existing P-TECH industry partners at schools that received P-TECH designation from the TEA. Participants were identified and contacted by phone or email with an invitation to participate in the study. Once the participants agreed to participate in the study, an email was sent to each participant containing a consent form and an explanation of the study. The consent form outlined the study, the interviews as being recorded, and any risks or benefits to the participant involved in the study. Prior to the interview, each participant submitted the signed consent form by email.

Each participant participated in a semi-structured individual face-to-face interview. An interview protocol served as a guide and starting point; however, the sequence, pace and use of clarifying and probing questions was unique to each participant in order gain a full description of their experience (Hayes & Singh, 2012). After all interviews were conducted the interviews were transcribed verbatim utilizing an electronic and secure transcription service. As part of the data analysis, the themes were sent to participants for review in order to complete member checks. Participants were asked to note needed clarifications, additions, or corrections to the emergent themes prior to completing the presentation of the findings (Mertens, 2010).

Interviews conducted during this qualitative study were comprised of an informal, interactive process consisting of open-ended questions (Moustakas, 1994). The researcher utilized an open-ended interview question guide for each participant. The researcher recorded each participant's interview with a digital recording device. The interviews lasted approximately 60 minutes. The question guide included background questions, probing questions related to each research question (RQ), and closing questions. The purpose developing a series of questions in advance was to assist with evoking a comprehensive account of industry partners experience of the phenomenon; however, the questions were varied, altered, or not utilized as the participant shared the full story of their experience related to answering any questions as asked (Moustakas, 1994). The interview questions follow.

Background Questions

1. What is your position and role within the company?
2. How long has your company served as P-TECH industry partner?
3. Why do you believe your company decided to become a P-TECH industry partner?
4. What is your role within the P-TECH program regarding your company's service as an industry partner?

RQ 1: What are industry partners' perceptions of how the P-TECH program prepares students to enter STEM careers?

1. Describe your company's experience as a P-TECH industry partner.

2. How have those experiences helped prepare students to become professionals in STEM fields?
3. Based upon your experiences as an industry partner, in what ways do you feel students are prepared to enter middle skill level jobs in the STEM field? In what ways students are not prepared?

RQ 2: What are industry partners' perceptions of how the school district engages with business and industry partners in developing career pathways which align with Texas HB5 requirements?

1. What is your company's role in assisting the school district and college with the planning and implementation of P-TECH program?
2. Describe your company's experience in terms of engagement with the school district and college related to identification of career pathways offered in the P-TECH program.
3. What experiences have you had related to skills mapping and designing curriculum for the P-TECH program?
4. What are your experiences related to interacting students and their parents/guardians regarding the P-TECH curriculum and future employment opportunities?

RQ 3: What do industry partners' perceive as successes and challenges associated with the P-TECH program?

1. As an industry partner, what successes have you experienced?
2. What challenges have you faced in fulfilling your partnership roles?

3. What do you perceive as advantages of the P-TECH program?

4. What do you perceive as disadvantages?

5. What advice do you have for superintendents or district administrators about their ongoing relationships with industry partners?

6. What advice do you have for P-TECH college partners about their ongoing relationships with industry partners?

7. What advice do you have for future industry partners that would help them find success with P-TECH engagement?

Closing Questions

1. What advice would you give to superintendents about to start a P-TECH program in their district based upon experience as an industry partner?

2. What else, if anything, would you like to tell me about your experience as an industry partner, particularly about preparing students to enter into the STEM field?

Data Analysis

The study was conducted using a qualitative research design to explore the meaning, structure, and essence of the lived experiences of P-TECH industry partners (Moustakas, 1994). Prior to conducting interviews, the researcher used a reflective journal to bracket personal experiences regarding the phenomenon. After completing the *epoche*, the process of suspending judgement (Hays & Singh, 2012), individual interviews were scheduled with each participant. After completing each interview, the researcher listened to the recording and verified the notes' accuracy. The researcher

compiled a list of statements based upon the conceptual framework of the study that were significant and relative to description of the experience. All relevant statements were annotated in order to begin identifying units that were meaningful to the P-TECH phenomenon (Moustakas, 1994). The chunks of information were utilized to develop codes. According to Hayes and Singh (2012), a code is a label that groups data based upon the defined unit of analysis. The codes were created based upon the P-TECH design principles and the strategic partnerships conceptual framework by Eddy and Amey (2014). Once codes were identified within each transcript, the researcher validated the data codes representing each transcript with the applicable participant.

After all transcripts were validated, the researcher returned to the transcripts to identify emerging themes that occurred between the transcripts as related to the industry partners' perceptions the P-TECH program and to their roles in relation to preparing students to enter the workforce as middle-skill level STEM professionals. The themes were then synthesized to develop a description of the textures of the experience (Moustakas, 1994). The identified patterns were utilized to construct an in-depth description of the experience (Moustakas, 1994). The analysis was conducted using Dedoose, a secure computer application for qualitative data organization.

The researcher analyzed the information to identify patterns. The identified patterns were utilized to construct descriptions of the P-TECH partner experience (Moustakas, 1994). The researcher completed this process to develop individual descriptions from the data collected from each participant. Then, the researcher constructed a single set of findings based upon the composite of the individual

descriptions, thereby developing a universal description of the P-TECH Industry Partner experience representing the participants as a whole (Moustakas, 1994).

The seven themes that emerged from the data were: (a) value alignment, (b) future employment opportunities and skills mapping, (c) mentoring and workplace learning experiences, (d) champions, (e) effective communication, (f) positive experiences, and (g) opportunities for improvement emerged from the participants' responses. The themes aligned to the theoretical framework. First, Eddy and Amey (2014) defined value alignment as partnerships established based upon similar goals. Second, future employment opportunities and skills mapping referred to the process of aligning the taught curriculum with the technical skills required to work within the information technology field (Mittal et al., 2019). Third, mentoring and workplace learning experiences were the activities in which the industry partners provided events, coursework, workplace visits, and internships designed to help students develop the skills necessary to transition into careers in information technology (IBM, 2012). Fourth, champions were leaders in the partnerships who brought the organizations together, brokered resources and helped resolve problems between the partnering organizations (Eddy & Amey, 2014). Fifth, effective communication involved sharing information in a manner beneficial to advancing the goals of the partnership (Eddy & Amey, 2014). Sixth, positive experiences occurred because of interactions described by this study's participants as meaningful, impactful, or valuable. Seventh, opportunities for improvement represented those instances in which the participants found outcomes to be less than favorable or did not result in achieving the anticipated goal. Figure 5 provides a

visual aid to understanding the codes by participant that were used to determine the core themes presented.

Media \ Codes	Champion	Strategic Leadership	Communication	College partner	marketing	organization and planning	Employment Opportunities	Opportunity for Improvement	Area for growth	Barrier to success	Challenge	Positive Experience	Skills mapping	Curriculum development	Value Alignment	Workplace Learning	Professional Skills	Technical Skills	internships	mentoring	Totals
Frank	6		3	3			3	5	1		3	6	3	2	1	5	1	4		1	47
Edna	9	1	6	2	2	2	1	8	7			6	4		5	6	1		2	3	65
Dawn	3	3						7	3	1	1		3		1	3	2		1		28
Charles	2	2	2	1			2	11	5	2	4	5	5		2	9	1	1	1	6	61
Brenda	9	2	7	2	3		1	13	6	1	2	12	2		4	13	6		3	5	91
Angela	5		3	1	1		4	5	3			8	5		1	7		1	2	4	50
Totals	34	8	21	9	6	2	11	49	25	4	10	37	22	2	14	43	11	6	9	19	

Figure 5. Visual guide to the participants and their codes.

Limitations

The limitation of this study was that the researcher only interviewed six industry partners, which limited the study findings to be generalized across all P-TECHs. Since the industry partners in the study supported one large urban school district, the data might not generalize to other school district P-TECHs in the state or nation. Additionally, the industry partners in the study supported only one curriculum pathway, so data might not generalize to other school STEM pathways. The interviewer audio recorded the interviews which might have limited the participants' responses. Unknown personal biases attributed to the researcher, a central office employee in a large urban district, might have affected the interpretation of information.

Creditability

One strength of this study is the specific criteria the researcher set for the participant selection. The selection process ensured that each participant has experienced the P-TECH phenomena. Also, by having the participants having served as an industry partner for two years their experiences are rich in their current setting. While all participants are P-TECH industry partners each school implementing the P-TECH program has varying characteristics.

In order to protect the participants, the researcher ensured that all identifying information in the interviews was not used in the findings without properly disguising the information. Industry partners discussed the current P-TECH program structures and district personnel; therefore, it was important to preserve their anonymity. The researcher used pseudonyms to identify the participants and their companies.

The researcher was a practitioner in a large urban district and served as an early college high school (ECHS) and P-TECH program administrator. Though experience as an administrator was helpful in understanding the inner workings of ECHS and P-TECH, unknown personal bias might have existed. Unknown biases, if left unchecked, could have led to the researcher constructing meaning based on the researcher's past experiences and not on the participants' perceptions. Prior to analyzing the data collected, the researcher set aside prejudgments regarding the phenomenon being investigated in order to launch the study to the extent possible free of preconceptions, beliefs, and knowledge of the phenomenon from prior experience (Moustakas, 1994). In order to set aside prejudgments, the researcher recorded thoughts in a journal utilizing the core

conditions that guide research reflexivity to guide the process of self-reflection (Hayes & Singh, 2012). The pursuit of reflexivity was used to establish a method for avoiding bias in the data analysis as well as yield an opportunity to engage with the data meaningfully.

Summary

This chapter provided the methods used for this qualitative study. This chapter included the methodology and procedures, purpose of the study, research questions, research design, data collection and procedures, instrumentation, participants, credibility, and data analysis. The purpose of the qualitative study was to examine the experiences of six P-TECH industry partners supporting a large urban school district in Texas and their perceptions regarding the impact of the P-TECH program in preparing students to enter the workforce. The researcher investigated industry partners' experiences of engaging with the urban school district and area community colleges as part of implementing P-TECH programs that prepared students to enter into the workforce as middle skill level STEM professionals. The participants' interviews lasted approximately 60 minutes. The question guide included background, probing, and closing questions. The researcher used the data to construct a single set of findings based upon the composite of the individual's lived experiences, thereby developing a universal description of the P-TECH Industry Partner experience representing the participants as a whole (Moustakas, 1994). The construction of the findings, the emergent themes, and the answers to the research questions appear in Chapter 4.

Chapter 4: Results

Educators must embrace their roles as partners with employers in order to help students successfully enter into the workforce. As the need for STEM professionals becomes greater, the need for organizational change related to effective partnerships with industry professionals is needed. As one solution, P-TECH programs are formed based upon a partnership between high school, college and industry partners. The P-TECH design allows K-12 educational systems and institutions of higher education to gain a deeper understanding of the evolving needs of employers (IBM,2012).

The purpose of the qualitative study was to examine the experiences of six P-TECH industry partners supporting a large urban school district in Texas and their perceptions regarding the impact of the P-TECH program in preparing students to enter the workforce. The researcher investigated industry partners' experiences of engaging with the urban school district and area community colleges as part of implementing P-TECH programs that prepared students to enter into the workforce as middle skill level STEM professionals. The urban school district had 18 TEA designated P-TECH programs and recruited 77 industry partners to support P-TECH programs throughout this large district. Industry partners from a representative sample of the P-TECH partners were interviewed about their lived experiences implementing the P-TECH program. This researcher conducted the study to answer the following questions:

1. What are industry partners' perceptions of how the P-TECH program prepares students to enter into STEM related careers?

2. What are industry partners' perceptions of how the school district engages business and industry in developing career pathways which align with Texas HB5 requirements?
3. What do industry partners perceive as successes and challenges associated with the P-TECH program?

This chapter includes a description of the emergent themes, description of the P-TECH partnership experience, answers to the research questions and summary of findings.

Core Themes of the Experience

The researcher compiled a list of statements based upon the conceptual framework of the study that were significant and relative to description of the experience. The participants interviews were analyzed, and all relevant statements were annotated in order to begin identifying structures that were meaningful to the P-TECH phenomenon (Moustakas, 1994). As a result, the participants' responses to questions in their individual interviews revealed the following seven themes: (a) value alignment, (b) future employment opportunities and skills mapping, (c) mentoring and workplace learning experiences, (d) champions, (e) effective communication, (f) positive experiences, and (g) opportunities for improvement. Each theme is described with quotes from the participants to demonstrate the nature of the theme. The word cloud in Figure 6 provides a visual representation of the frequency in which the codes were applied based upon the participants' responses.

Figure 6. Word cloud of key codes leading to seven themes.

Theme 1: Value Alignment

All participants indicated their company became a P-TECH industry partner because the P-TECH program aligned with the vision, mission, or goals of the company. Angela, Chief Executive Officer, said, "We became a P-TECH industry partner because it is aligned with our mission and our vision. We are a company that is focused on helping people unlock their potential, and P-TECH aligns with that." Edna, Vice President of Human Resources, stated the company serves as an industry partner because, "The goals and objectives of P-TECH aligned with our corporate citizenship strategy of impacting individuals to earn the education to get a job or start a business."

Other participants had similar responses regarding the alignment of the P-TECH program with organizational goals. Charles, Chief Executive Officer, explained the company's

mission to help prepare students for careers in STEM were aligned the purpose of the P-TECH program which was the basis for the company becoming an industry partner. Brenda shared that everyone benefits from the P-TECH program as follows:

> P-TECH is a partnership between business and the city and education and the colleges. [P-TECH] had all the right stakeholders at the table to actually do something meaningful, not just look like you were doing something because people knew there was a problem. This was getting to the heart of why we have some of the problems that we have, and I just saw win/win/win benefits for everybody who was going to get involved with this.

Dawn, Project Manager, explained that the opportunity for students to earn a high school diploma and an associate degree was something the company found extremely beneficial for students. Frank, Senior Manager, discussed the need for the company to help to cultivate talent as a motivating factor for being a P-TECH industry partner.

The theme of value alignment emerged when participants were asked why their company become a P-TECH industry partner. Most participants shared their companies' missions and goals or corporate citizenship strategies and initiatives as the basis for having an interest in becoming a P-TECH industry partner. As a result, value alignment appeared as an important theme in developing the strategic partnership to support the P-TECH program for most participants.

Theme 2: Future Employment Opportunities and Curriculum Alignment

The theme of future employment opportunities and curriculum alignment resonated in a wide variety of the participants' responses. Five out of six participants

provided data supporting the emergence of this theme. Charles expressed that the P-TECH program students at the high school with which their company partners will be well prepared to enter jobs in robotics, electronics, and engineering. Charles stated that the students "have good classes that they're taking. I'm providing good mentorship so that they understand what each job entails." Angela expressed that being an industry partner provides an opportunity for companies to groom future employees that understand the culture of the organization. as follows:

> For an industry partner to be able to spend four years with a potential employee is unheard of, to train them to be ready for work. Most of the time you hire employees, you hired them because you thought they were going to be a good fit and a couple of months in, if it lasts that long, you start to recognize that they're not a good cultural fit. So, I think the greatest advantage for the industry partner is you can almost spend four years crafting the perfect talent to fit into your organization.

While most participants shared that P-TECH provides an opportunity to cultivate talent for future employment opportunities they also discussed the need to engage deeper with high school and college partners to ensure that the students skill set match employment needs. Frank discussed the importance of working collaboratively with the high school and college partners to outline the skills required to prepare students for future employment opportunities with skills mapping:

> That's an important part of it. So, when we start looking at the skills map, [we ask] how does that apply into the industry and what is the industry doing? Again, we try to look at us as part of that barometer because we have those hiring needs.

Brenda stated:

> When it comes to our involvement with the actual curriculum, I feel like we've been a little light on that. We've had some opportunities to participate, both at the high school and at the community college, to give input into some of [the curriculum].

Angela echoed the desire to provide input more regarding the curriculum stating:

> I would say at a granular level we've had conversations with some of our college partners and school partners. I think that is an area that can improve, being able to help inform the actual schoolwork and course load before it happens, not as it's happening.

To summarize the theme future employment opportunities and curriculum alignment, participants shared the need to provide more guidance to their education partners regarding the curriculum to help ensure that coursework aligns to the skills required to secure employment for P-TECH students. Some participants had the opportunity to provide high school and college partners with information pertaining to the technical skills required for future employment opportunities and emerging trends in the industry. However, all shared that skills mapping and curriculum alignment connected to future employment opportunities as an area for improvement within the P-TECH program.

Theme 3: Mentoring and Workplace Learning Experiences

All participants discussed mentoring and workplace learning experiences within the P-TECH program when answering the first and third questions. This theme emerged throughout the interviews as each participant described their experiences interacting with students enrolled in the P-TECH program. Dawn, Local Market Lead, shared that the company provided summer internships for P-TECH students through the Mayor's Summer Internship Program. Edna stated:

> I would say the most beneficial role that we've played in helping the students prepare for STEM fields is through the internships. [The internships have] been an 8-week summer experience for [students] to have the opportunity to come into a company and learn not only the jargon but the way decisions are made, the processes, the technology testing, understanding how technology is used in business and seeing behind the scenes has made a huge difference.

Angela's company has also provided students with the opportunity to apply the technical skills acquired through participating in the development of deliverables for the company. Frank shared that connecting student experiences to future employment opportunities is important.

Overall participants explained that mentoring and workplace learning opportunities exposed students to their industry and provided a vehicle for students to apply professional and technical skills in a real-world setting. Four participants discussed providing internships for P-TECH students which focused on the development of professional skills. Two participants shared ways in which students utilized technical

skills obtained through coursework during internships in their companies. Five participants provided details about the various ways in which their company mentored students in the P-TECH program. Based upon the participants' responses mentoring and workplace learning are the components of the P-TECH program in which the companies are most actively engaged.

Theme 4: Champions

Champions emerged as a theme when participants discussed their roles in securing resources and obtaining support for the P-TECH program within their various companies. All the participants described their individual experiences leveraging company resources to support the P-TECH program. Brenda described using the resource of personnel:

> The program asks you to dedicate a certain amount of internal time of a resource [person] to focus on the program. At first, I was resistant to that because we just didn't have the bandwidth. The longer we've been involved [with P-TECH], the more I see that is the right ask and that is the right model.

Angela discussed the need to identify key individuals within the company to support the implementation of the program in the following:

> Advice I have for future industry partners is to think outside the box as far as how you can support students. And what I mean by that is [P-TECH partnership] might immediately scream to somebody that we need to get human resources involved, but the reality is most companies have several different departments that can lean in and support a team. So, whether it's your IT [information technology]

> department, whether it's marketing and graphics, social media to be open as far as what that looks like and to find passionate individuals that can lead this cause. That's probably the Number 1 most important thing is to identify whether it's a team of people or one person that really is passionate about this initiative and can champion it for your organization.

Edna shared similar thoughts regarding engaging a team to support the P-TECH program. Edna stated that P-TECH provides "an opportunity not only to engage from a leadership perspective, but also to engage our employees and more junior employees as well." As champions for the P-TECH program, the participants solicited support from within their companies to mentor students, participate in various program activities, supplement the curriculum, or provide resources. Dawn shared that serving as the program coordinator for the industry partner includes collaborating with the high school and college partners to determine how individuals from within the company can support student learning.

Edna utilized the opportunity of providing student internships as an example to demonstrate the importance of champions within the company to support the P-TECH program. Edna stated, "4 years ago we did not have opportunities for high school interns. My engagement with P-TECH really sparked my interest to further explore how can I make that happen at my company. And here we are 4 years later, we're now moving into the third year of bringing on summer internships for P-TECH students." Having a champion to support the P-TECH program resonated in responses from participants as a vital component when implementing a P-TECH program.

Theme 5: Effective Communication

Five out of six participants discussed the importance of effective communication. The theme emerged as participants responded to the second and third questions during the interview. Participants discussed the importance of communicating effectively in order to achieve positive outcomes. Angela shared the following about the essential need to communicate with senior level staff members:

> It's very important to have a consistent flow of communication, and I also think it's very important that when you work with an organization, you really get buy in from the most senior level possible and let that trickle down.

Other participants highlighted the significance of developing systems to communicate effectively across organizations. Brenda discussed the value of regular communication. Brenda stated:

> [The school] insisted on a few structural things, like either weekly or biweekly telephone meetings between their workplace coordinator and our HR point of contact, mainly just to stay synced up and stay aligned and made sure that those lines of communication were open, so that when ideas did come up, we were in front of them as early as possible. . . .
>
> I think having that liaison is very helpful to manage the industry partner expectation, and . . . the schools.

Edna shared, "I have been verbose about [communication]. I would say to position me for success as an industry partner, so what that means is I need specifics on what you need from me and [the] timelines." Brenda further expressed the need to help

high school staff members understand the nuances required for successful engagement with industry partners. Brenda discussed assisting the high school with:

> Putting some corporate structure around how they have the interactions with the corporate partners, so that the school looks like it's a professional organization, not like a school interacting with students. That's a hard thing for some of the schools to recognize, that when they're dealing with businesspeople, it's very different than interacting with a group of captive students who are here at the school all the time, or with other teachers or administrators.

Participants also discussed the importance of communicating effectively with college partners. Frank's organization spends a significant amount of time discussing the curriculum with the college partner. Frank shared that the company's leaders believe that it is important to remain in communication with the college partner because technology changes. Frank expressed that constant communication ensures that the college credit hours obtained by students align with workforce demands.

Other participants expressed the desire to have more effective communication with college partners. For example, Charles shared that there was limited interaction between the company and the college partner. Charles stated:

> We don't know what happens when the kids get to their junior year, and they go on to the community college for half a day or a full day. I'm not sure what happens there . . . What are they learning? How can the industry partners influence what they're learning because they could be taking something that's outdated?

This theme revealed that effective communication is vital to strategic partnerships. Participants expressed the importance of discussing the curriculum with the education partners to help create a seamless pathway to employment opportunities for graduating students. Additionally, effective communication is critical to maintain positive working relationships among the various partner organizations.

Theme 6: Positive Experience

Throughout the individual interviews, participants expressed that the effort to implement the P-TECH program with high school and college partners was a positive experience. Frank described the experience as follows:

> I think [the P-TECH partnership] has been great. It's still early on. We're into our third year. I think we often have ambitious goals that we often must reevaluate, re-pivot. What we thought was going to happen one way doesn't necessarily it's going to happen that way. So, I think what this is, it is a huge learning experience.

Angela echoed those sentiments by saying:

> Our experience has been very impactful, not only on myself but my team, in really grounding the work that we done. Working and coming to know how educators and administrators function to help prepare future leaders has been very interesting, but you can tell across the board that everyone is dedicated to their job. Overall, our experience has been really uplifting and encouraging and energizing for our mission as a company
>
> . . . I feel like the students graduating from [P-TECH] programs really are top of the line in the sense that they've even been able to make it through completing

high school and college coursework on top of extracurricular activities and industry partner engagement.

Edna shared that the growth of the P-TECH program was exciting and participating in the program was rewarding due to the scale of implementation. Edna responded:

> There are a number of successes from the industry partner perspective. I would say just seeing the evolution in the strength of the program, come from just a few industry partners around the table, just eight schools, to now 18 schools. It's just the sheer breadth and stretch and reach of the program. I would say it has been a great program to hang our hat on. I guess is the best way to say it. It's something that is a staple in the community that has over the years been an easy conversation to have with others in the community and in the business community because they know what you're talking about. It's been great to help other companies understand and learn how to bring on interns and what that looks like for them.

Other participants, such as Brenda and Charles, identified establishing positive relationships with students and participating in their growth and development as meaningful outcomes of the P-TECH program. Charles stated, "I'm most proud of, the relationships we've been able to build with the students and get them excited about future technology." Brenda responded:

> Being able to see the same students [repeatedly] and watch their confidence grow, where they would start to raise their hand and speak in front of not only their teachers, but they'd speak in front of the industry partners. Then, they spoke in

front of the state board of education representative when she came to the school. They were very articulate and willing to share every experience that they had had and what they appreciated. Just watching the students build themselves up has been very fulfilling.

Edna identified student growth and development as a measure of success pertaining to the P-TECH program and added the following:

> Other successes I would say obviously is positioning the students to work hand in hand with our employees and with our leadership team and to learn something new. It's great to see that students have an opportunity to advance their education, those that who have not been otherwise advanced in their education. That's an amazing outcome.

The theme positive experience emerged as participants identified successes within the P-TECH program. Participants shared that engaging in the P-TECH program was meaningful and rewarding. Most participants were proud to discuss their contribution to the growth and development of students in the P-TECH program.

Theme 7: Opportunities for Improvement

All participants saw opportunities for improvement within the P-TECH program. The theme emerged as participants responded to the third question of the interview. The participants highlighted the tightly structured pathways and providing industry partners with a greater opportunity to inform the curriculum as the greatest areas for improvement. Dawn explicated:

> These pathways are developed. Sometimes, they're so narrow in focus and then when the curriculum is done, it even tightens it up even more. Maybe that is the intention, but I'm thinking for high school students who are still trying to get to know who they are . . . [the curriculum] needs to be able to be a bit more fluid.

Brenda echoed the same sentiment as follows:

> The computer information technology pathway at our school started out with a lot more students in it, and they've thought like, "Oh, this is not what I thought. I want to do something else." It's like, "No, no. You're a junior, baby. You got to keep going and finish this up, because right now you're 3 years in." I think that's a little bit that double-edged sword. It's a benefit to a lot of students, but I think for some of them [the pathway] might feel limiting.

Frank identified the need for more flexibility within the curriculum. Frank stated:

> If you keep the program [i.e., pathway] to where people [students] can't shift, that [rigidity] can cause them to go into a [pathway] that may not be as well suited for them. Make [the pathway] as flexible as possible so that they can earn their high school diploma as well so they can get their associate degree with an emphasis in a subject that is more conducive into the marketplace because it changes so much and so rapidly.

Angela discussed the need to develop courses within the program in order to create year-round internship opportunities:

> What's interesting is in wanting to expose the students to what it's like to work and to actually give them internships, we're limited to the summer right now. On

> any given school day, we're working and functioning, and we could expose students to what our work is like, but because they are in school, that's limited. An opportunity is building in internship credits . . . so [students] can have more exposure throughout the entire year versus just throughout the summer.

Additionally, participants reported the desire to have greater opportunities to inform the curriculum. Charles shared the following:

> We haven't had a lot of synergy as far as forming the curriculum itself. I think some of those have already been formed on the collegiate level. I think it'd be advantageous though to be involved in that part of it with the community council. I think it'd be great if we were involved.

Edna expressed:

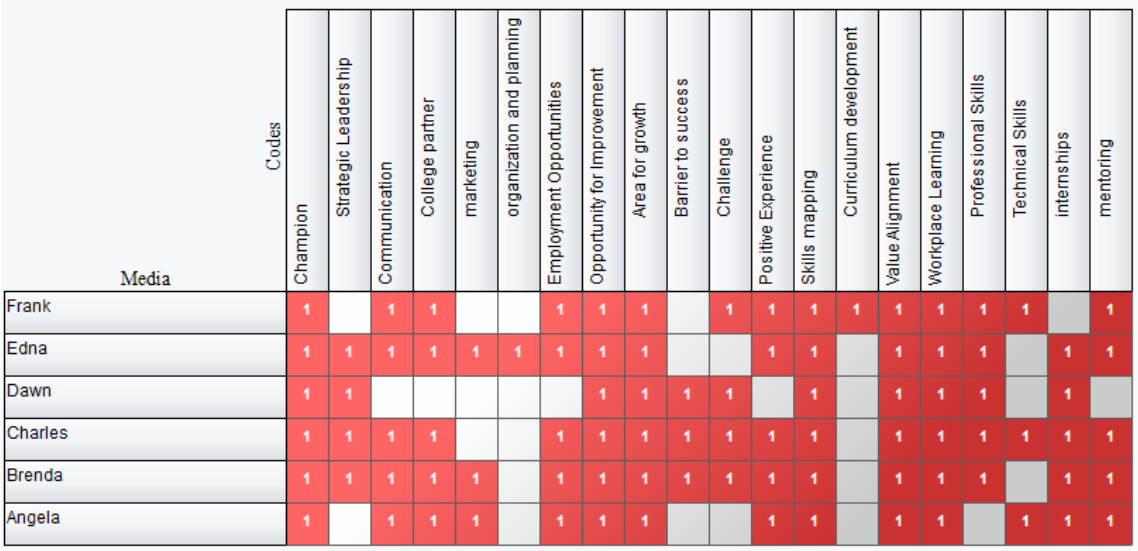
> I have not, per se, as an industry partner been asked to participate in [a deep] level of curriculum planning and implementation however we would be happy to contribute to that. So, I would say that's an opportunity, and we'd be happy to engage.

Based upon the participants' responses the greatest opportunities for improvement are creating flexibility within the curriculum pathways and allowing industry partners to inform curriculum design.

P-TECH Partner's Experiences

The themes from the participant's experiences were utilized to construct descriptions of their experiences in their roles as P-TECH partners (Moustakas, 1994). These narratives explain the participants' individual lived experiences with the P-TECH

industry partner phenomenon (Moustakas, 1994). The individual descriptions of each P-TECH industry partnership were developed from the verbatim transcribed interviews of each participant (Moustakas, 1994). The individual transcripts were examined to understand each P-TECH industry partner's individual experience (Moustakas, 1994). The descriptions that follow present the essences of the P-TECH industry partner experience for each participant (Moustakas, 1994). The codes that formed from the data are presented in Figure 7 according to the participant who provided them.



Media \ Codes	Champion	Strategic Leadership	Communication	College partner	marketing	organization and planning	Employment Opportunities	Opportunity for Improvement	Area for growth	Barrier to success	Challenge	Positive Experience	Skills mapping	Curriculum development	Value Alignment	Workplace Learning	Professional Skills	Technical Skills	internships	mentoring
Frank	1		1	1			1	1	1		1	1	1	1	1	1	1	1		1
Edna	1	1	1	1	1	1	1	1	1			1	1		1	1	1		1	1
Dawn	1	1						1	1	1	1		1		1	1	1		1	
Charles	1	1	1	1			1	1	1	1	1	1	1		1	1	1	1	1	1
Brenda	1	1	1	1	1		1	1	1	1	1	1	1		1	1	1		1	1
Angela	1		1	1	1		1	1	1			1	1		1	1		1	1	1

Figure 7. Participants' code intersections for presenting the experiential descriptions.

Angela

The P-TECH industry partnership experience for Angela involved providing valuable workplace learning experiences and creating opportunities for students to utilize technical skills. The structures that permeated Angela's P-TECH industry partnership experience are value alignment, mentoring that falls under mentoring and workplace

learning, employment opportunities and skills mapping, being a champion, effective communication, positive experiences, and opportunities for improvement. Angela stated:

> We are a company that is focused on helping people unlock their potential, and P-TECH aligns with that. Our company has really given students the opportunity to use practical application of their skills. I feel like the students graduating from these [P-TECH] programs really are top of the line in the sense of if they've even been able to make it through completing high school and college coursework on top of extracurricular activities and industry partner engagement.

Angela provided the education partners with information that affected the curriculum and worked collaboratively with both the high school and college partners. Angela shared:

> I've sat in on a couple of curriculum planning sessions with our college partners to inform them of the certifications that are important to us [technology industry], especially with software programming. There are so many different [programming] languages that students can learn. We've really played a role in informing [the high school and college partners] of what the most innovative [programming] languages that students can learn are which will assist them with immediately get a job anywhere.

Angela described ways in which the company has mentored students and provided workplace learning experiences:

> We were developing a new feature and included students in the process. Students were engaged in the process of helping the company understand the problem we

> were trying to solve and designing the feature to solve that problem. Students were also included in follow-up sessions with our designers. The students gave the designer feedback on how well they thought designer solved that problem. The feedback from students was incorporated and students were part of the final review process.

Angela's description of the P-TECH industry partner experience informed all seven of the themes discussed in the previous section.

Brenda

The P-TECH industry partnership experience for Brenda was focused on developing meaningful relationships and providing opportunities for students. The structures that described Brenda's P-TECH industry partnership experience were value alignment, mentoring and workplace learning, being a champion, effective communication, positive experiences, and opportunities for improvement. Brenda stated:

> I serve as an executive sponsor for the program. It's my job to make sure that our company dedicates the right amount and type of resources toward the [P-TECH] program. Our company is deeply committed to helping prepare especially women and minorities to take advantage of all the opportunities that are available in STEM fields.

Brenda stated the following when describing ways in which the company has mentored students and provided workplace learning experiences:

> Our company has hosted close to 40 interns through the P-TECH program. All the P-TECH students at our partner high school have toured our office. We begin the

tours when students are in ninth grade. We've shared with students how every single job at our company requires the extensive use of a computer.

Brenda discussed multiple advantages for students in the P-TECH program in the following explanation:

> The first one, giving high school students the opportunity to get any amount of college credit without cost to them or their family, is the biggest, biggest benefit. The second thing, putting these students in a school-within-a-school environment, where they're very concentrated with the same kids repeatedly, they've got a lot of oversight, [and] they see the same teachers. Other advantages [include] being focused on careers, seeing companies, getting to interact with other adults that are not teachers, seeing what corporate people look like, and seeing what they act like. All [the workplace learning experience] is a big advantage, and I think in ways that the kids won't even appreciate until later.

Brenda expressed the company has not provided much guidance or assistance informing the P-TECH program curriculum. Brenda stated about "our involvement with the actual curriculum, I feel like we've been a little light on that. We've had some opportunities to give input [in curriculum development], both at the high school and at the community college." Brenda highlighted the need to provide more effective training for the high school workplace learning coordinators. Brenda stated. "The experiences that the industry partners are having with each of the schools is very uneven. I would have much better and more robust training for workplace coordinators." Brenda's experience

as a P-TECH industry partner informed all seven of the themes discussed in the previous section.

Charles

The P-TECH industry partnership experience for Charles involved prioritizing mentoring to build each student's confidence and to increase student awareness of opportunities for employment within the STEM profession. The structures that explained Charles's P-TECH industry partnership experience were value alignment, champion, mentoring and workplace learning, effective communication, future employment opportunities and skills mapping, positive experiences and opportunities for improvement. Charles shared that the overall experience as a P-TECH industry partner has been positive. Charles stated the experience has "been a good one because I have a great relationship with the students. I'm highly engaged with the students. That's probably been the best part about" the experience with the P-TECH program. Charles highlighted the significance of mentoring students by sharing the following statement:

> Enrollment in the logistics pathway was low until I became an industry partner. Students were not enrolling in the pathway because they did not understand the what type of work included in the logistics field. As a result of my involvement in the P-TECH program, the students went from thinking logistics was about using forklifts to understanding work in logistics includes use of drones.

Charles further stated, "[P-TECH] exposes the students to the careers of the future. It gives them an opportunity to meet a potential mentor, the company leadership, and possibly a job for the future."

Charles also discussed the working relationship with campus administrators and workplace learning coordinators. Charles shared, “I assist the workplace learning coordinators with [designing] the workplace experiences by helping them to identify the types of jobs students should explore, [selecting] field trips and [assisting students with writing] resumes and how to interview properly.” Charles expressed the desire to have a more meaningful relationship with campus administrators, which resonated in the following statement:

> It would be a little bit more helpful if the school administrators were learning from the industry partner so [school administrators would] know how to speak to who [the industry partners] are and what they [industry partners] bring to the table.

However, Charles explained that the company was able to guide campus administrators in making a major purchase that was impactful. Charles shared:

> Within the first 5 days [of my company becoming] an industry partner, I looked at the equipment [the high school campus administrators] were going to order with grant funds and informed them that they were ordering outdated equipment. I changed what they were ordering to a more efficient and effective product. I think they were very pleased with [the input I provided regarding the purchase].

As it relates to skills mapping, Charles shared that the company has had limited involvement in developing the curriculum. Charles stated, “We haven’t had a lot of synergy as far as forming the curriculum.” Charles also suggested recruiting additional small businesses to support the P-TECH program. Charles said:

> I think there should be more small companies because they [small companies can] engage with students at a different level. Plus, I think that from a small company standpoint, it not only shows [students] what industry careers could look like, but it also shows entrepreneurship.

Charles's experience as a P-TECH industry partner informed all seven of the themes discussed in the previous section.

Dawn

The P-TECH industry partnership experience for Dawn was complex as the company was continuing to determine how to best support the students and the P-TECH program. Dawn expressed excitement and challenges associated with implementation of the P-TECH program. The structures that explained Dawn's P-TECH industry partnership experience were value alignment, champion, mentoring and workplace learning, and opportunities for improvement. Dawn said, "Knowing that students are able to graduate with their high school [diploma] and their associates [degree] and then they're halfway through completing a 4-year university degree is one of the key selling points of the overall program."

Dawn explained that the company became a P-TECH industry partner to help generate a pipeline of future employees. Dawn stated, "Thinking about the Information Technology industry, in just preparing future workforce leaders, I think it's [P-TECH] just an overall benefit for everyone." Dawn shared that the company has supported the P-TECH program by providing summer internships for students. Dawn also discussed

challenges the company has faced with creating opportunities for students to apply the technical skills contained in the curriculum:

> Bridging that gap [between the curriculum and workplace learning experience] is one of the things that I find difficult as we try to engage our students with us as an industry partner. We are exploring that [bridging the gap] by creating something that's project-based, but again, I personally don't think we've done well at that just yet. I would say one of our challenges is providing hands-on support.

While providing workplace learning experiences that are technical in nature has been a challenge, Dawn did share that the company has worked to support students in developing professional skills in general. Dawn expressed, "I think the stronger part is our support in working with the school has been more so along the lines of helping to develop students' professional skills." Dawn's experience as a P-TECH industry partner informed four of the seven of the themes discussed in the previous section.

Edna

The P-TECH industry partnership experience for Edna is working to help achieve the company's corporate citizenship goals and objectives. The structures that detailed Edna's P-TECH industry partnership experience were value alignment, mentoring and workplace learning, future employment opportunities and skills mapping, being a champion, effective communication, positive experiences, and opportunities for improvement. Edna discussed value alignment as motivation for the company becoming a P-TECH industry partner. Edna stated, "The goals and objectives of P-TECH aligned

with our corporate citizenship strategy of impacting individuals to earn the education to get a job or start a business." Edna championed the P-TECH program:

> I have led, over the last 4 years, our company's engagement with P-TECH. And the rationale behind that is, one, it's a personal interest, and I wanted to see it through and to ensure that what I started is successful.

Edna added, "I am looking to spread my wings a bit and get more people involved with supporting the [P-TECH] initiative." Edna discussed the various ways that the company has participated in mentoring and workplace learning activities. Edna stated:

> Our experience has been one that we have provided our employees with opportunities to volunteer to impact the students whether it be from career readiness trainings, providing speaking opportunities or evaluating large scale student projects.

Edna stated employee engagement with the students is impactful. Edna shared:

> Student entrepreneurs in the business pathway have come [to our offices] for the past 2 years to present projects they've created. The students pitch and sell their products. It's important [to connect our P-TECH students and our employees]. The students have won the hearts of our employees.

Edna also explained the company has provided student summer internships for the past 3 years and "would say the most beneficial role that we've played in helping the students prepare for STEM fields is through the internships." Regarding the curriculum, Edna said:

> I have not per se, as an industry partner, been asked to participate in [a deep] level of curriculum planning and implementation; however, we [our company] would be happy to contribute to [curriculum development]. I feel like I can't say [the curriculum is] good or it's not good, because I don't know. When [the students] go off to the college level, that's where I feel the gap is, in positioning my understanding [of the curriculum] so that I can speak to what they're [students are] learning, what the context is and how the instructional courses that they're taking or credits feed into job opportunities, or even align with our requirements. So, until I see something like that, I [must] trust it.

Edna's experience as a P-TECH industry partner informed all seven of the themes discussed in the previous section.

Frank

The P-TECH industry partnership experience for Frank was deeply rooted in helping to cultivate talent to address the immediate need for employees with technical skills within the company. The structures that described Frank's P-TECH industry partnership experience were value alignment, champion, mentoring and workplace learning, effective communication, future employment opportunities and skills mapping, positive experiences, and opportunities for improvement. Frank shared the two reasons the company became a P-TECH industry partner. Frank stated:

> I think [our company's] interest in servicing communities is one aspect of [our choice to become an industry partner]. The second aspect of it was the opportunity to help students achieve a degree in technology. In hopes that we can

bring them into our company through being part of an initiative that we can design to grow and develop future employees for our company.

Frank explained:

> What we face in our industry, in IT [information technology], in this city is not enough technical talent. Therefore, the prices that developers will charge us [our company] is much higher because they know that the market is there for them. So, we spend a lot of money on contracting because of that. What we're trying to do [with P-TECH and other company initiatives is] build and grow that talent.

Participant one shared that the most impactful way that the company is helping to build the talent pipeline is through mentoring. Frank stated:

> The number one way that we offer to the students is the mentoring. However, that mentoring builds from exposure to experience. Part of it is, is a lot of students come into it and really don't understand what information technology is or how it's used. They understand the basic components. That's a PC, that's a laptop, that's a mobile phone. But there's all the intricacies that go into that product, different parts and methods of programming. We help the [college partner] connecting students learning to how [the concepts] are really going to be used in the technology world.

Frank shared that student interest is the biggest challenge faced within the P-TECH program. Frank stated:

> I think the biggest challenge, it's the number one challenge, is does the student really want to do it? That's the key. If the student doesn't want to do it, then their

> heart's not into it. I feel [students] just need to really, truly understand what they want to do when choosing a degree program.

Frank shared student interest is a concern because the company is seeking candidates for employment and has invested in the development of the program to ensure students are ready to enter the workforce. Frank said:

> We work closely with the dean of the STEM program to determine how can we ensure the courses taken align with industry needs if they [students] decide to go and join the workforce. Our commitment is [the students are] very well prepared.

Frank's experience as a P-TECH industry partner informed all seven of the themes discussed in the previous section.

Composite of the P-TECH Partner Experience

The individuals' lived experiences were integrated to form a universal description (Moustakas, 1994) of the P-TECH industry partnership that could represent the participants' lived experiences collectively. Emergent themes from participants interviews were analyzed to form the composite description of industry partnership with K-12 and college partners to prepare students to enter STEM careers (Moustakas, 1994). Through examination of the emergent themes, the group's synthesized description of the successes and challenges experienced were identified. This data synthesis provided the foundation for understanding the essence of the P-TECH industry partner phenomenon.

All participants explained their motivation to partner was based upon value alignment and the need to develop a pipeline of talent for future employment opportunities. Participants shared ways in which they have mentored students, provided

workplace learning experiences, and generated resources to support the P-TECH program. Four out of six (66%) participants reported that their company provided summer internships for students. One participant shared that prior to becoming a P-TECH industry partner, their company did not offer internships to high school students.

Providing workplace learning experiences resonated from the participants' responses as a success of the program; however, having an opportunity to inform the curriculum surfaced as an area for improvement. Participants shared the educational pathways needed to have greater flexibility for allowing students to select a different program of study as they advanced in the program if needed, to adapt to changes in the field, and to have opportunities for internships during the school year, not in the summer only. Despite the identified challenges associated with the curriculum, five out of six (83%) participants discussed student growth and development in the P-TECH program favorably.

Two participants discussed witnessing an increase in student confidence. Others discussed students' ability to complete both high school and college coursework as a strength. All the participants discussed ways in which they have contributed to the development of students' professional skills. Throughout the interview participants described ways in which they have personally provided or secured resources and support for P-TECH students and the P-TECH program. Therefore, each of the participants were champions for the P-TECH program.

All participants discussed alignment between the P-TECH program and organizational goals or the mission of their respective companies. Each shared positive

experiences and opportunities for improvement based upon their experiences as a P-TECH industry partner. Participants described positive relationships with students formed through mentoring and workplace learning activities. Four participants (66%) described students' opportunity to earn a high school diploma and an associate degree as a significant benefit of the P-TECH program. Four participants (66%) expressed the need to have greater participation in developing the curriculum. Two participants (33%) explained ways in which they have informed the curriculum. Each of the participants (100%) were champions who solicited resources and support for the P-TECH program within their respective companies.

Findings for the Research Questions

There were seven themes that emerged from the interview data that answered the three research questions. Participants responses to the interview protocol established the themes and answered the research questions. Overall, collaboratively developing systems and effectively communicating in order to build trusting relationships among and between the industry partners, colleges, and school district helped to advance the P-TECH partners through the various stages of strategic partnerships in order to implement the program.

Research Question 1

The first research question was: What are industry partners' perceptions of how the P-TECH program prepares students to enter STEM related careers? The question explored ways in which P-TECH industry partners described their experiences of working collaboratively with K-12 and college partners to prepare students for the

workforce. The following four themes discussed in the analysis section were relevant to answering this research question: (a) champions, (b) future employment opportunities and skills mapping, (c) mentoring and workplace learning, and (d) positive experiences. The themes emerged from analysis of participants responses to the interview protocol.

Research Question 2

The second research question was: What are industry partners perceptions of how the school district engages business and industry partners in developing career pathways which align with Texas HB5 requirements? The question examined participants' involvement with designing and implementing P-TECH program curriculum. The three themes applicable to answering the research question were the following: (a) future employment opportunities and skills mapping, (b) effective communication, and (c) opportunities for improvement.

Research Question 3

The third research question was: What do industry partners perceive as successes and challenges associated with the P-TECH program? Participants reflected upon their experiences as P-TECH industry partners highlighting successes, challenges, and areas for growth. The participants' responses to this question were captured in the two themes of positive experiences and opportunities for improvement.

Summary

This chapter provided the findings derived from qualitative interviews with two chief executive officers, two executives responsible for corporate citizenship, a senior manager responsible for technology and software development, and a program manager.

Data analysis revealed the following emergent themes in their responses: (a) value alignment, (b) future employment opportunities and skills mapping, (c) mentoring and workplace learning experiences, (d) champions, (e) effective communication, (f) positive experiences, and (g) opportunities for improvement.

The research questions were answered. All participants reported positive experiences and opportunities for improvement based upon their perceptions as a P-TECH industry partner. Participants described mentoring and workplace learning as the primary means in which they interact with students pertaining to their preparation to enter STEM careers. Four participants described students' opportunities to earn both the high school diploma and the associate degree as a benefit of the P-TECH program.

Two participants explained ways in which they have informed the curriculum. The remaining participants expressed that participating in curriculum development activities is an opportunity for improvement. Four participants discussed the need to have greater flexibility within the pathways in order to adapt to student needs or changes in the field. Each of the participants served as champions having solicited resources and support for the P-TECH program within their respective companies. Chapter 5 presents the discussion and conclusion to the study.

Chapter 5: Discussion, Implications, & Conclusions

Given the demand for a more skilled workforce and the need to improve post-secondary completion rates, school districts are working to increase the number of students who have access to post-secondary education prior to high school graduation. The academic benefits of students participating in dual enrollment programs include increased academic rigor during the junior and senior years of high school, overall academic success for students, and facilitation of the transition between high schools and colleges (Jones, 2013). The TEA's (2018) P-TECH Blueprint calls for industry partners guide educators through a skills mapping process which identifies the skills required for entry-level jobs targeted for students graduating from P-TECHs. After the workplace skills are identified, they are utilized to develop a 6-year plan to educate students to perform those skills. The P-TECH curriculum is derived from the partners' workplace and employment needs (IBM, 2012).

As part of preparing P-TECH high school students for career readiness, industry partners engage with students through a variety of workplace learning experiences, which include mentoring, job shadowing, and internships. The first cohort of graduates from P-TECH programs in Texas graduated in May 2020. Prior to this study, there was little substantial evidence of success from the perspectives of industry partners regarding whether their demand for middle skill level professionals was met. Therefore, data needed to be collected to determine what experiences industry partners had and what value they associated with P-TECH partnerships.

The following research questions were explored to help superintendents understand the motivation to partner and the benefits, successes, and challenges associated with implementation of P-TECH programs from the perspective of industry partners:

1. What are industry partners' perceptions of how the P-TECH program prepares students to enter STEM related careers?
2. What are industry partners' perceptions of how the school district engages business and industry in developing career pathways which align with Texas HB5 requirements?
3. What do industry partners perceive as successes and challenges associated with the P-TECH program?

In this chapter, I will outline several key takeaways from the study and implications of how those findings may inform research, policy, and practice. First, a discussion of each research question will be presented to help shape our understanding of P-TECH programs based upon the perspective of the industry partners that participated in the qualitative study. Next, I will provide implications for future research and policies that can impact the implementation and collaboration among P-TECH partners in the district and other districts. Finally, I will offer recommendations for future study.

Discussion of Findings

The P-TECH design principles by IBM (2012) and the strategic partnerships model by Eddy and Amey (2014) were used to create the conceptual framework that informed the study and recommendations for P-TECH industry partnerships included in

this chapter. Seven themes emerged from the interview data that answered the three research questions. The themes were: (a) value alignment, (b) future employment opportunities and skills mapping, (c) mentoring and workplace learning experiences, (d) champions, (e) effective communication, (f) positive experiences, and (g) opportunities for improvement. Based upon the findings, the researcher concluded that value alignment, building trust, and effective communication are essential in establishing strategic partnerships among industry partners, colleges, and school districts to achieve P-TECH program goals.

Research Question 1

The first research question asked: What are industry partners' perceptions of how the P-TECH program prepares students to enter STEM related careers? The question explored ways in which P-TECH industry partners describe their experience working collaboratively with K-12 and college partners to prepare students for the workforce. The four themes relevant to answering this research question were champions, future employment opportunities and skills mapping, mentoring and workplace learning, and positive experiences. The data showed that the P-TECH industry partners worked collectively with high school and college partners by supplementing the curriculum helping to prepare students to obtain jobs within the information technology field. As a result, the researcher concluded workplace learning experiences are an essential component of the P-TECH program and establishing strategic partnerships with business and industry is vital to the success of P-TECH programs.

Workplace learning experiences are an essential component of the P-TECH program, and establishing strategic partnerships with business and industry is vital to students' success. P-TECH industry partners work collaboratively with high school and college partners by supplementing the curriculum helping to prepare students to obtain jobs within the STEM field (IBM, 2012). P-TECH partnerships are valuable in achieving sound educational outcomes and can be of benefit to students and to each organization involved (Amey et al., 2010).

Eddy and Amey (2014) stated that "strategic partnerships are formed based on a sense of purpose and for what they contribute in helping leaders meet institutional goals and objectives" (p. 1). The first phase of the strategic partnership model includes the antecedents for each of the partners to contribute their reasons for initiating or joining an existing partnership (Amey et al., 2010). The P-TECH program's goal of preparing students to enter STEM professions served as the motivation for the companies to begin to engage in the process of becoming an industry partner. This study's participants described desiring to help students obtain the knowledge and skills required to obtain jobs within the information technology field as their major role as a P-TECH industry partner. The participants' desire to cultivate talent for employment opportunities as motivation for partnership supports findings by Symonds, Schwartz, and Ferguson (2011) who concluded there is a need for K-12 education to focus on promoting career development, expanding partnerships with postsecondary institutions, and collaborating with industry professionals to address skills gaps.

IBM's (2012) P-TECH design principles recommended creating an integrated workplace experience through partnership with business and industry. All participants described experiences which demonstrated ways that the company provided work-based learning activities. In addition to aligning with the P-TECH design principles, the descriptions of the workplace learning experiences shared by the participants were reflective of the characteristics of work-based learning activities outlined in the TEA (2018) P-TECH blueprint. Work-based learning was also described in the TEA's (2018) blueprint as relevant, high-skill work-based learning experiences that respond to student interest and regional employer needs and contribute to students earning aligned industry certifications and credentials.

The mentoring experiences described by the participants were indicative of student support as outlined in the TEA P-TECH Blueprint. The TEA (2018) defined student support as:

> Wrap-around strategies and services involving multiple stakeholders to strengthen both the academic and technical skills necessary for high school and college readiness, as well as provide academic, technical, and individual support for students to be successful in rigorous academic and work-based learning experiences. (p. #12)

The work-based learning activities and mentoring provided by the industry partners served as catalyst to help prepare students to enter STEM professions.

Additionally, the TEA P-TECH Blueprint called for partnerships with business and industry to be formalized by a MOU between the K-12, college and industry partners.

TEA requires the MOU to include an agreement that the regional industry or business partner will give to a student who receives work-based training or education from the partner under the P-TECH program priority when applying and interviewing for any jobs for which the student is qualified and are available upon the student's completion of the program (TEA, 2018). Executing the MOU advances the organizations into the second phase of the partnerships model.

The second phase of the strategic partnership captures the processes involved in developing the collaboration beyond the self-interest of partners (Amey et al., 2010). According to Eddy and Amey (2014) in the second phase, the partnership evolves beyond the rigidity of the formal contract and becomes a more informal and flexible relationship. In the second phase of the strategic partnership, it is important to develop systems for communication that build trust and maintain compatibility (Eddy & Amey, 2014). Maintaining and sustaining industry partnerships is vital to the P-TECH program being able to ultimately achieve the goal of increasing the number of students successfully transitioning from the program into a career in STEM.

Research Question 2

The second research question asked: What are industry partners perceptions of how the school district engages business and industry partners in developing career pathways which align with Texas HB5 requirements? The question examined participants involvement with designing and implementing P-TECH program curriculum. The themes that answered the research question were future employment opportunities and skills mapping, effective communication, and opportunities for improvement. The researcher

found that there were limited opportunities for the industry partners to inform the curriculum. The researcher concluded it is important to create feedback loops to provide an opportunity for industry partners to inform the curriculum and to give equal voice to all three entities (industry, high school, and college) forming the P-TECH partnership in order to increase the potential longevity of the partnership.

In order to increase the potential longevity of P-TECH partnerships, it is important to establish feedback loops among the partners to provide the opportunity for industry partners to inform the curriculum and to give equal voice to all three entities. P-TECH industry partners shared that they provided workplace learning experiences and internships; however, there were limited opportunities to participate in skills mapping exercises which aligned the curriculum with future employment opportunities. The MOU required the industry partners to provide first-in-line opportunities for P-TECH graduates to interview for positions within the company. Therefore, to ensure that students have the requisite knowledge and skills required for employment, it is essential that industry partners are included in the design of the curriculum and pathways offered within the P-TECH program. The industry partners in this study indicated that they did not have enough opportunity to make contributions to curriculum design.

P-TECH program is a partnership between high school, college and industry partners, the program design aligns with the three primary components of the School-to-Work Opportunity Act (STWOA, 1994) that include school-based learning, work-based learning inclusive of mentoring, and connecting activities designed to coordinate work and school-based learning. The STWOA was the foundation for establishing career

academies. Kemple and Willner (2008) found that career academies provided a viable pathway to postsecondary education; however, they did not create better occupational opportunities for students. Kemple and Willner observed that students in career academies were offered essentially the same set of academic courses and course requirements as those offered to other traditional high school students.

While P-TECH programs and career academies were designed based upon the fundamental purpose to increase the number of students that graduate career ready, students enrolled in P-TECH programs have the potential to achieve different outcomes. P-TECH programs are designed for students to earn post-secondary credentials. The TEA's (2018) P-TECH blueprint required P-TECH programs to provide a rigorous course of study to enable participating students to receive a high school diploma, an associate degree, postsecondary certificate provided by an IHE, or industry certification during Grades 9 through 14.

The workplace learning experiences and internships provided through P-TECH programs supplemented the curriculum and provided an opportunity for students to connect academic learning with the skills needed in the industry partners' workplaces. Although Kemple and Willner (2008) found that career academy programs exhibited small or negligible impacts on labor market outcomes, P-TECH programs have the potential to positively affect the labor market. P-TECH programs may have a positive impact because industry partners agree to provide first-in-line opportunities for P-TECH graduates to interview for positions within the company. Yet, to fully achieve this goal,

industry partners must have a voice in the development of program design and curriculum pathways.

Research Question 3

The third research question asked: What do industry partners perceive as successes and challenges associated with the P-TECH program? The question was designed to identify the experiences the participants classified as accomplishments or areas for improvement. The participants' responses formed the two themes of positive experiences and opportunities for improvement. Participants shared positive reflections of their experiences mentoring students, providing workplace learning experiences, and offering summer internships. The P-TECH industry partners described experiences in which they interacted with students or secured resources for the P-TECH program as accomplishments. The successes described by the industry partners were reflective of the shared values among the partners. All participating partners demonstrated a vested interest in the success of the P-TECH program's students in hopes of developing talent to help meet the demand for skilled professionals in their companies. The researcher concluded the opportunity to scout future employees is beneficial to P-TECH industry partners and presents itself as one of the motivating factors for companies to join the partnership.

P-TECH industry partners found the opportunity to scout future employees was valuable and enabled them to view the partnership as a positive experience. P-TECH industry partners described their interactions with students and efforts to secure resources for the P-TECH program as accomplishments. The participants described interactions in

which they mentored students as meaningful. Relationships are core to the ability to build effective partnerships (Eddy & Amey, 2014). “Relationship building occurs within and among various levels of the involved institutions and includes individuals in a range of positions of responsibility” (Eddy & Amey, 2014, p. 47). The researcher found the relationships established between the industry partners and students during workplace learning ensured mentoring was a vital component of the P-TECH partnerships. The relationships between P-TECH industry partners and students was informal; however, the partners valuing their relationships with the P-TECH students represented one of the most significant outcomes.

The researcher found participants believed the systems for communicating about curriculum design among the high school, college, and industry partner is an area for growth. Participants articulated the need to better inform the curriculum to ensure the taught curriculum aligned with the rapid changes within the industry. This opportunity for improvement emerged from challenges participants encountered during development of the strategic partnership with the school district and college and based on unestablished protocols for effective communication. Feedback loops and systems for effective communication are essential to advance partnerships through the developmental stage in order to sustain the relationship. Strategic partnerships are sustained when the relationship evolves to the place where the partnership is greater than the sum of its parts (Eddy & Amey, 2014). P-TECH partnerships require the establishment of feedback loops that result in each partner having a role in helping the others and contributing to knowledge building among all entities within the partnership.

The study's findings support research that was included in the literature review. The participants' desire to inform the curriculum also aligns with the following conclusion by Grand (2017):

> The demand for STEM jobs is growing at a faster rate than general job growth across industries, and simultaneously the skills demanded by STEM employers have evolved much faster than the STEM curriculum used by school systems. (p. #1)

In order to achieve the goal of preparing students to transition into STEM careers, industry partners need to have an equitable voice in informing the program's pathways to ensure the curriculum aligns with employers' needs. According to Eddy and Amey (2014), "a collaborative partnership entails mutual respect, and acknowledgement of others' voices, strengths, values and assets" (p. 62). Based upon participants' responses, the researcher concluded a shared decision-making process that has a formalized system to obtain feedback needs to be implemented because it is essential to building and maintaining effective partnerships. "Feedback loops provide information on what is required to change or adjust as a result of the original decision" (Eddy & Amey, 2014, p. 60). These formal feedback loops can contribute to each partner's ability to contribute to knowledge building among all entities within the P-TECH program.

Implications

This study provided in-depth information regarding the industry partners' experiences as strategic partners of a P-TECH program. Education practitioners engaged in P-TECH partnerships might use these findings to understand the motivations,

successes, and challenges associated with the implementation of P-TECH programs from industry partners' perspective. With an understanding of how partnerships with business and industry come together and what facilitates or challenges their longevity, educators can construct more effective strategic alliances between sectors to address education and workforce learning needs (Amey et al., 2010).

The implications are presented within the context of Eddy and Amey's (2014) strategic partnership model. The first phase of the model focuses on the motivations to partner. It is important for educators to understand the reasons and factors that influence a company to become an industry partner. The researcher found participants in the study were motivated to partner based upon value alignment and the need to develop a talent pipeline for future employment opportunities. These factors contributed to the industry partners willingness to provide workplace learning experiences inclusive of mentoring students and providing internships. The motivations leading a company to partner may influence the longevity of the relationship (Eddy & Amey, 2014). Therefore, educators are encouraged to develop an on-boarding process designed to uncover the underlying assumptions had by potential industry partners and to discuss explicitly the motivations for partnership prior to moving to formalize the partnership. These motivations that need to be explored and discussed include a company's goals and anticipated outcomes.

The second phase of the model consists of the processes to develop collaboration beyond the self-interest of partners (Amey, et. al, 2010). This phase also includes formalizing the partnership through contracts or MOUs. Additionally, during this phase it is important for partners to collectively develop systems for communication and decision-

making. “How partnerships begin sets the stage for future interactions and sets expectations for communication and information sharing” (Eddy & Amey, 2014, p. 55).

The participants expressed the systems for communication about curriculum between high school, college, and industry partners needed to be improved. Furthermore, the researcher concluded that feedback loops are needed to provide the ongoing opportunity for industry partners to inform the curriculum and to ensure there is an equality of voice among all three entities forming the P-TECH partnership. By establishing a feedback loop, the potential longevity of the partnership would be ensured. Therefore, an implication for practice is for P-TECH partners to collectively establish a structure for decision-making that includes feedback loops that allow for assessing progress toward achieving P-TECH program goals, modifying and adapting the curriculum, and informing all entities of each other’s continual improvement efforts.

The second phase of the model also includes forming relationships. Eddy and Amey (2014) stated that “what often begins with a formal process increasingly relies on a social process as the partnership progresses and becomes more institutionalized” (p. 13). Relationships are the cornerstone of partnerships. P-TECH programs are comprised of a partnership between K-12 school systems, institutions of higher education and industry partners. However, the researcher found the relationships between industry partners and students were an important component of the P-TECH program. Participants shared their positive experiences of interacting with students. Although several participants expressed having concerns about students’ interest in persisting in the information technology pathway. As such, interactions with students and student persistence in the pathways may

impact the partnership designed for cultivating talent for future employment opportunities and the motivation of the industry partner. As a result, an implication for practice is for K-12 educators to develop a tool to access students' interest in the program's specific pathways prior to their enrollment in the P-TECH program.

The third and final phase of the strategic partnership model by Eddy and Amey (2014) is partnership capital. Partnership capital represents the evolution of the partnership that occurs "when there is networking, when shared beliefs regarding the focus and processes of the partnership are created, and when time spent working as a team results in a sense of shared norms and an alignment of processes" (Amey et al., 2010, p. 342). Symonds et al. (2011) found that solutions to address the skills gap involve developing programs to accelerate high school students' skills development through earning postsecondary STEM certificates and credentials. Symonds et al. concluded that workplace learning experiences are an essential component of the P-TECH program and establishing strategic partnerships with business and industry is vital to students' success in acquiring the technical knowledge and skills required to obtain a job in the technology field upon graduating from the P-TECH program. Given the essential role that industry partners play within P-TECH programs, educators need to utilize the strategic partnership model as a framework to establish, maintain, and sustain partnerships with business and industry. According to Eddy and Amey (2014) strategic partnerships can result in tangible outcomes and create organizational change. It was clear this study's findings offer opportunities for improving the delivery of P-TECH programs.

The final implication involves P-TECH programs, Texas HB5, and graduation requirements. HB5 was enacted to help ensure students obtain the skills necessary to enroll in post-secondary education or procure employment (Aycock & Davis, 2014). The Foundation High School Program provides an opportunity for students to earn endorsements in specific areas of study inclusive of STEM. However, to earn distinguished achievement students must complete 26 credits inclusive of four credits of math including Algebra II, four credits of science, all FHSP curriculum requirements and earn an endorsement. P-TECH students earning an Associate degree, completing 12 hours of college academic courses or earning a nationally or internationally recognized business or industry certification may also earn a performance acknowledgement on their high school diploma and transcript (Required coursework, §19 TAC chapter 74, subchapter G.; Graduation requirements, §19 TAC chapter 74, subchapter B.). In order to complete the FHSP, college degree requirements and participate in work-based learning activities, P-TECH students can remain enrolled in high school for six years (TEA, 2018).

Given that P-TECH program goals include addressing regional workforce demands, the 6-year enrollment time span may prohibit companies with immediate hiring needs from pursuing the opportunity to become a P-TECH industry partner. The specified courses required for high school graduation and college degree completion were identified as an area of concern by several of the study participants. Other participants discussed their companies' limited opportunities for informing the curriculum. Therefore, an implication for policy is for lawmakers is to consider reducing the number

of core content courses required for P-TECH students in order to create an opportunity for industry partners to assist school districts and colleges with designing innovative courses aligned with workforce needs. Additionally, reducing the number of required courses in the core content areas may help students to graduate from P-TECH programs with a high school diploma, associate degree, industry recognized certification, and work-based learning experiences within 4 years.

Recommendations for Future Study

P-TECH industry partnerships provide students with direct exposure to industry professionals in STEM fields in order to equip graduates with the knowledge and skills to successfully transition into the workforce. The purpose of this study was to gain a deeper understanding of P-TECH industry partner experiences, perspectives regarding program implementation, and roles in the P-TECH partnership. In the following paragraphs I present several recommendations for future study.

First, a case study research design can help to examine the P-TECH program from the voices of school administrators and college partners in addition to industry partners. Data collected from the case of study may provide additional, in-depth insight into successes and challenges with implementation of programs. Data may also provide district administrators with insight regarding best practices for implementing P-TECH programs in the future.

Second, a longitudinal, mixed methods study for analyzing the success of the P-TECH program in accomplishing its goals of increasing the number of students earning post-secondary credentials and entering STEM professions. The first P-TECH opened in

New York in 2011; therefore, the first cohort of students in the P-TECH program graduated from high school in 2015. That graduating class, and each subsequent one, can be tracked to measure the trends of the partnership's success in accomplishing its goals.

Third, a qualitative study of industry partners representative of different STEM pathways and careers. There are various industries represented by the STEM pathways that are offered in P-TECH programs. This study was a qualitative study of industry partners within the information technology field. The study of P-TECH industry partners could be replicated to understand the phenomenon based upon the perceptions of industry partners in other STEM-focused pathways, such as healthcare. The purpose of the study would be to gain a deeper understanding of the successes, challenges and outcomes based upon P-TECH program implementation.

Lastly, a mixed methods study of the impact of P-TECH program graduates on STEM industries within a regional market. The P-TECH program was designed to address the skills gap in regional markets through partnership of educational institutions and industry partners. P-TECH program goals include the opportunity for students to earn industry-recognized certificates and postsecondary credentials in addition to workplace learning experiences provided by the industry partners based upon the respective pathways. Studies that measure the impact of these graduates on their industries' regional markets, and any subsequent trends, could provide valuable knowledge affecting the cost-benefit analyses of implementing P-TECH programs in other school systems.

Conclusion

The purpose of this study was to examine the experiences and perceptions of P-TECH industry partners regarding the impact of the P-TECH program in preparing students to enter the workforce. Six P-TECH industry partners of the information technology pathway were interviewed about their perceptions of working collaboratively with K-12 school districts and college partners to implement the P-TECH program. The purpose of the study was achieved, and all research questions were answered. There is a demand for STEM professions and P-TECH industry partners play a vital role in helping to prepare P-TECH graduates to enter STEM careers. The participants identified value alignment and addressing workforce needs as motivation for the company to become a P-TECH industry partners. The industry partners discussed providing workplace learning activities inclusive of mentoring and internships. The P-TECH industry partners described their role helping to bridge the gap between the curriculum and application of the concepts in the information technology field. The industry partners expressed an interest in having more instances to inform the curriculum and pathways to help ensure alignment between the curriculum and students' future employment opportunities. Through the formation strategic alliances with colleges and industry partners, P-TECH programs have the potential to address the demand for professionals with the academic, professional and technical skills necessary to enter STEM careers. These partnerships can be mutually beneficial, particularly if the Eddy and Amey (2014) strategic partnership model is applied by school districts establishing, maintaining and sustaining partnerships in order to achieve P-TECH program goals.

A final thought involves the timing of this study's presentation. The ability of the P-TECH model to be relevant to current economic circumstances is highlighted in this time of the COVID-19 pandemic which has mandated the closure of schools, colleges, and businesses throughout the nation. The P-TECH offers a way for not only information technology but also healthcare pathways to meet staffing needs in periods of increased demands. As a result of the shelter in place regulation school systems are challenged with operating virtually for an unspecified timeframe, suggesting an increase in available information technology workers may be needed to enable the computer systems and software to be deployed for meeting school district's needs efficiently. While the lasting effects of the COVID-19 pandemic are yet to be determined, this situation manifested the importance of cultivating talent more quickly than the traditional 4 years of high school followed by 4 to 6 years of undergraduate education allows. In order to create a pipeline of professionals entering the information technology field, P-TECH may represent an industry critical to the economy during a unique moment in history.

References

Abdul-Alim, J. (2017, June). P-TECH: A promising industry-school partnership. *Diverse*, 18–20.

ACT. (2007). *Rigor at risk: Reaffirming quality in high school core curriculum*. Iowa City, IA: ACT.

ACT. (2016). *The condition of college and career readiness 2016.* Iowa City, IA: Retrieved from https://www.act.org/content/dam/act/unsecured/documents/CCCR_National_2016.pdf

Adams, C. J. (2013, June 12). Advanced courses: Finding America's missing AP and IB students. *Education Week*, p. 5. Retrieved from http://link.galegroup.com/apps/doc/A334806857/OVIC?u=txshracd2598&xid=d59435e2

Alliance for Excellent Education. (2006). *Paying double: Inadequate high schools and community college remediation*. Washington, DC: Retrieved: from http://www.all4ed.org/files/archive/publications/remediation.pdf

American Institutes for Research. (2014). *Early college, continued success: Early college high school initiative impact study*. Retrieved from https://www.air.org

American Institutes for Research. (2019, September). *Early college, continued success: Longer-term impact of early college high schools*. Retrieved from http://www.ccdaily.com/2019/09/early-college-students-continued-success/

Amey, M. J., Eddy, P. L., & Campbell, T. G. (2010). Crossing boundaries creating community college partnerships to promote educational transitions. *Community College Review, 37*(4), 333–347. doi:10.1177/0091552110365725

An, B. P. (2013). The impact of dual enrollment on college degree attainment: Do low-SES students benefit? *Educational Evaluation and Policy Analysis, 35*, 57–75. doi:10.3102/0162373712461933

Aycock, D., & Davis, J. (2014). *TASA HB5 summary final report*. (Legislative Report).

Balestreri, K., Sambolt, M., Duhon, C., Smerdon, B., & Harris, J. (2014). *The college and career readiness and success organizer.* Washington, DC: American Institutes for Research. Retrieved from https://ccrscenter.org/sites/default/files/College%20and%20Career%20Readiness%20and%20Success%20Organizer%20Brief_FINAL.pdf

Barnard-Brak, L., McGaha-Garnett, V., & Burley, H. (2011). Advanced placement course enrollment and school-level characteristics. *NASSP Bulletin, 95*(3), 165–174. doi:10.1177/0192636511418640

Behie, S. W., & Henwood, M. K. (2018). Closing the skills gap. *Chemical Engineering Progress, 114*(6), 36–41. Retrieved from https://www.aiche.org/resources/publications/cep/2018/june/closing-skills-gap

Berger, A., Adelman, N., & Cole, S. (2010). The early college high school initiative: An overview of five evaluation years. *Peabody Journal of Education, 85*(3) , 333–347. Retrieved from https://peabody.vanderbilt.edu/faculty/pje/pje_volume_85_issue_3_2010/abstract_berger_et_al.php

Bergeron, L. (2015). *Diploma Programme students' enrollment and outcomes at US postsecondary institutions 2008-2014*. Geneva, Switzerland: International

Baccalaureate. Retrieved from https://www.ibo.org/globalassets/publications/ib-research/dp/dp-student-enrollment-outcomes-us-en.pdf

Blankenberger, B., Lichtenberger, E., & Witt, A. M. (2017). Dual credit, college type, and degree attainment. *Educational Researcher, 45*(6), 259–263. doi:10.3102/0013189X17718796

Bragg, D. D., & Taylor, J. L. (2014). Toward college and career readiness: How different models produce similar short-term outcomes. *American Behavioral Scientist, 58*(8), 994–1017.

Business high school; educating technologists. (2015, Jul 18). *The Economist, 416*, 26. Retrieved from http://ezproxy.lib.utexas.edu/login?url=https://search-proquest-com.ezproxy.lib.utexas.edu/docview/1697409326?accountid=7118

Bureau of Labor Statistics. (2018). *College enrollment and work activity of recent high school and college graduates summary*. Retrieved from https://www.bls.gov/news.release/hsgec.nr0.htm

Carter, H. M. (2004). *A case study of middle college high school, 1972--2003: An effort to improve the persistence of at-risk students in high school and to facilitate their access to college* (Doctoral dissertation. Retrieved from ProQuest Dissertations & Theses database. (UMI No. 3124943)

Chen, X. (2016). *Remedial course taking at U.S. public 2- and 4-year institutions: Scope, experiences, and outcomes* (NCES 2016-405). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubsearch

Christo-Baker, E., Sindone, A., & Roper, C. (2017). Addressing the skills gap: A regional analysis. *Journal of Applied Business and Economics, 19*(8), 10–21. doi:10.33423/jabe.v19i8

College Board (2018) *AP program summary report*. Retrieved from: https://secure-media.collegeboard.org/digitalServices/pdf/research/2018/Program-Summary-Report-2018.pdf

Cullen, C. (1991). Membership and engagement at middle college high school. *Urban Education, 26*(1), 83–105.

DiMaria, F. (2013). Mellon foundation: Supports for Latino doctoral students in humanities. *Hispanic Outlook in Higher Education, 25*(13), 16–18. Retrieved from https://www.questia.com

Early College High School Initiative. (2008). *Early college high school initiative: Core principles.* Retrieved from http://www.air.org

Early College High School Initiative. (2010). *Early college high school: A portrait in numbers.* Retrieved from http://www.earlycolleges.org

Eddy, P. L. & Amey, M.J. (2014). Creating strategic partnerships: A guide for educational institutions and their partners. Sterling, VA: Stylus Publishing.

Edmunds, J. A. (2012). Early colleges: A new model of schooling focuses on college readiness. *New Directions for Higher Education, 158*, 81–89. doi:10.1002/he.20017

Edmunds, J. A., Bernstein, L., Glennie, E., Willse, J., Arshavsky, N., Unlu, F., et al. (2010). Preparing students for college: The implementation and impact of the early college high school model. *Peabody Journal of Education, 85*(3), 348–364. Retrieved from https://peabody.vanderbilt.edu/faculty/pje/pje_volume_85_issue_3_2010/abstract_edmunds_et_al.php

Edmunds, J. A., Bernstein, L., Unlu, F., Glennie, E., Willse, J., Smith, A., et al. (2012). Expanding the start of the college pipeline: Ninth-grade fndings from an experimental study of the impact of the early college high school model. *Journal of Research on Educational Efectiveness, 5*(2), 136–159.

Edmunds, J. A., Unlu, F., Glennie, E., Bernstein, L., Fesler, L., Furey, J., et al. (2017). Smoothing the transition to postsecondary education: The impact of the early college model. *Journal of Research on Educational Efectiveness, 10*(2), 297–325. doi:10.1080/19345747.2016.1191574

Edmunds, J. A., Willse, J., Arshavsky, N., & Dallas, A. (2013). Mandated engagement: The impact of early college high schools. *Teachers College Record, 115*, 1–31.

Englander, M. (2012). The interview: Data collection in descriptive qualitative human scientific research. *Journal of Qualitative Psychology, 43,* 13–35.

Ferraro, K. F., Schafer, M. H., & Wilkinson, L. R. (2016). Childhood disadvantage and health problems in middle and later life: Early imprints on physical health? *American Sociological Review, 81*(1), 107–133. doi:10.1177/0003122415619617

Gale, S. (2018, May 16). P-TECH a lesson in closing the high tech skills gap: IBM's academic model helps high schoolers secure two-year degrees. *Workforce,* p. 10.

Retrieved from https://www.workforce.com/2018/05/16/p-tech-lesson-closing-high-tech-skills-gap/

Gewertz, C. (2010). College and the workforce: What 'readiness' means; after years of advocacy, attention is paying off. *Education Week*, p. 24. Retrieved from https://www.galegroup.com/apps/doc/A226055351/OVIC?u=txshracd2598&xid=ad5d2660

Giani, M., Alexander, C., & Reyes, P. (2014). Exploring variation in the impact of dual-credit coursework on postsecondary outcomes: A quasi-experimental analysis of Texas students. *High School Journal, 97*, 200–218. doi:10.1353/hsj.2014

Global Agenda Council on Skills and Talent Mobility and the Steering Board. (2011). *Global talent risk—seven responses*. Retrieved from http://www3.weforum.org/docs/PS_WEF_GlobalTalentRisk_Report_2011.pdf

Grand, S. (2017). *Canada's STEM skills crisis: Can P-TECH bridge the gap.* Washington, DC: Wilson Center Canada Institute.

Haxton, C., Song, M., Zeiser, K., Berger, A., Turk-Bicaki, L., Garet, M. S., . . . Hoshen, G. (2016). Longitudinal findings from the early college high school initiative impact study. *Educational Evaluation and Policy Analysis, 38*(2), 410–430. doi:10.3102/0162373716642861

Hershbein, B., & Kearney, M. (2014). *Major decisions: What graduates earn over their lifetimes.* Washington, DC: Brookings Institution. Retrieved from http://www.hamiltonproject.org/assets/legacy/files/downloads_and_links/Major_Decisions_Lifetime__Earnings_by_Major.pdf

Hershey, A. M., Silverberg, M. K., Haimson, J., Hudis, P., & Jackson, R. (1999). *Expanding options for students: Report to Congress on the national evaluation of school-to-work implementation*. Retrieved from http://www.mathematica-mpr.com/~/media/publications/PDFs/Expanding.pdf

Hinojosa, M., & Crozier, J. (2018, February 14). Dallas ISD has a plan to create the college-educated STEM workforce Dallas lacks. *Dallas Morning News*. Retrieved from: https://www.dallasnews.com/opinion/commentary/2018/02/14/dallas-isd-plan-create-college-educated-workforce-dallas-lacks

Hodara, M., & Jaggars, S. S. (2014). An examination of the impact of accelerating community college students' progression through developmental education. *Journal of Higher Education, 85*(2), 246–276.

Hoffman, N., & Vargas, J. (2010). *A policymaker's guide to early college designs: Expanding a strategy for achieving college readiness for all*. Retrieved from https://www.jff.org

Hoffman, N., Vargas, J., & Santos, J. (2009). New directions for dual credit: Creating stronger pathways from high school through college. *New Directions for Community Colleges*, *145*, 45–58. doi:10.1002/cc.354

Hoffman, N. & Webb, M. (2010). From hope to belief. *Educational Leadership, 67*(7), 54–48.

Hogan, A., & Roberts, B. (2015). Occupational employment projections to 2024. *Monthly Labor Review.* doi:10.21916/mlr.20549.

Holzer, H. J., & Lerman, R. I. (2009). *The future of middle-skills jobs*. Washington, DC: The Brookings Institution. Retrieved from http://www.brookings.edu/papers/2009/02_middle_skills_jobs_hozer.aspx

Howley, A., Howley, M. D., Howley, C. B., & Duncan, T. (2013). Early college and dual enrollment challenges: Inroads and impediments to access. *Journal of Advanced Academics*, *24*(2), 77–107.

IBM. (2012). *STEM pathways to college and careers schools: A development guide*. Armonk, NY: Author.

IBM. (2018). *Steering committee overview*. Retrieved from http://www.ptech.org/wp-content/uploads/2018/11/Steering-Committee-Overview.pdf

Jobs for the Future (2014*). Early college expansion: Propelling students to postsecondary success at a school near you*. Retrieved from http://www.jff.org

Jobs for the Future. (2011). *Making the grade: Texas early college high schools prepare students for college*. Retrieved from https://www.jff.org

Kaniuka, T., & Vickers, M. (2010). Lessons learned: How early college high schools offer a pathway for high school reform. *NASSP Bulletin, 94*(3), 165–183.

Karp, M. M. (2012). "I don't know, I've never been to college!" Dual enrollment as a college readiness strategy. *New Directions for Higher Education, 158,* 21–28. doi:10.1002/he.20011

Karp, M. M., & Hughes, K. L. (2008). Supporting college transitions through collaborative programming: A conceptual model for guiding policy. *Teachers College Record, 110,* 838–866.

Karp, M. M., Calcagno, J. C., Hughes, K. L., Jeong, D. W., & Bailey, T. R. (2007). *The postsecondary achievement of participants in dual enrollment: An analysis of student outcomes in two states*. New York, NY: Community College Research Center, Teachers College, Columbia University.

Kemple, J. J., & Willner, C. J. (2008). *Career academies: Long-term impacts on labor market outcomes, educational attainment and transitions to adulthood*. New York, NY: MDRC.

Kirsch, I., Braun, H., Yamamoto, K., & Sum, A. (2007). *America's perfect storm: Three forces changing our nation's futur*e. Princeton, NJ: Educational Testing Services.

Kisker, C. B. (2006). Integrating high school and the community college. *Community College Review, 34*(1), 68–86. doi:10.1177/0091552106289821

Klopfenstein, K. (2010). Does the advanced placement program save taxpayers money? The effect of AP participation on time to college graduation. In P. M. Sadler, G. Sonnert, R. H. Tai, & K. Klopfenstein (Eds.), *AP: A critical examination of the Advanced Placement program* (pp. 189–218). Cambridge, MA: Harvard Education Press.

Kochan, T., Finegold, D., & Osterman, P. (2012, December). Who can fix the 'middle-skills' gap? *Harvard Business Review*. Retrieved from https://hbr.org/2012/12/who-can-fix-the-middle-skills-gap

Koos, L. V. (1946). *Integrating high school and college: The six-four-four plan at work*. New York, NY: Harper and Brothers.

Lieberman, J. (2004). *The early college high school concept: Requisites for success. The early college high school initiative.* Retrieved from https://www.jff.org

Lieberman, J. E. (1986). *Middle college high school: Ten year study*. New York, NY: City University of New York. Retrieved from ERIC databse. (ED271153)

Ma, J., & Pender, M., & Welch, M. (2016). *Education pays: The benefits of higher education for individuals and society*. Retrieved from https://trends.college board.org/sites/default/files/education-pays-2016-full-report.pdf

Mathewson, T. C. (2018). Momentum builds for career-focused P-TECH schools. Retrieved from https://hechingerreport.org/momentum-builds-for-career-focused-p-tech-schools/

McFarland, J., Hussar, B., de Brey, C., Snyder, T., Wang, X., Wilkinson-Flicker, S., . . . Hinz, S. (2017). *The condition of education 2017* (NCES 2017-144). Washington, DC: National Center for Education Statistics. Retrieved from https://nces.ed.gov/ pubsearch/pubsinfo.asp?pubid=2017144

Mellor, L., Stoker, G., & Reese, K. (2015). *House bill 5 evaluation*. (Policy Evaluation No. 3255_08/15). Austin, TX: American Institutes for Research.

Miller, T., Kosiewicz, H., Wang, E. L., Marwah, E., Delhommer, S., & Daugherty, L. (2016). *Dual credit in Texas.* Retrieved from http://www.60x30tx.com/ media/1184/thecb-randinterimreportondualcredit.pdf

Miller, V., Fleming, R., & Reed, S. (2013). Mapping the early college research literature. *Community College Journal of Research and Practice, 37*, 664–676. doi:10.1080/ 10668926.2013.774892

MDRC. (2018, December). *An overview of the NYC P-TECH grades 9-14 model*. Retrieved from https://www.mdrc.org/sites/default/files/P-TECH%209-14%20Infographic%20-%20Final.pdf

Mittal, A., Dhiman, R., & Lamba, P. (2019). Skill mapping for blue-collar employees and organisational performance. *Benchmarking: An International Journal*, 26, 1255–1274. doi:10.1108/BIJ-08-2018-0228

Moustakas, C. (1994). Phenomenological research methods. Thousand Oaks, CA: Sage.

National Center for Education Statistics. (2013). *The condition of education 2013* (NCES2013-037). Washington, DC: U.S. Government Printing Office.

Nodine, T. (2009). *Innovations in college readiness: How early college high schools are preparing students underrepresented in higher education for college success*. Retrieved from http://www.jff.org

Ohrt, J. H., Lambie, G. W., & Ieva, K. P. (2009). Supporting Latino and African-American students in advanced placement courses: A school counseling program's approach. *Professional School Counseling*, *13*(1), 59–63. doi:10.1177/2156759X0901300104

Oreopoulos, P., & Petronijevic, U. (2013). Making college worth it: A review of the returns to higher education. *Future of Children*, *23*(1), 41–65. Retrieved from ERIC database. (EJ1015240)

Oreopoulos, P., & Salvanes, K. (2011). Priceless: The nonpecuniary benefits of schooling. *Journal of Economic Perspectives*, *25*(1), 159–184. doi:10.1257/jep.25.1.159

P-TECH. (2019). *History*. Retrieved from http://www.ptech.org/about/history/

Peralez, K. (2014). *Students' perception of the transition from an early college high school to a university* (Doctoral dissertation). Retrieved from https://repositories.lib.utexas.edu/handle/2152/44105

Perna, L. W. (2005). The benefits of higher education: Sex, racial/ethnic, and socioeconomic group differences. *Review of Higher Education, 29*(1), 23–52. Retrieved from Project MUSE database.

Perna, L. W., & Riepe, J. S. (2015). *Improving equity in higher education attainment: A national imperative*. Retrieved from http://pellinstitute.org/indicators/downloads/dialogues-2015_essays_Perna_Riepe.pdf

Pollock, C. F. (2009). *The impact of exposure to early college students on community college student academic and social integration* (Doctoral dissertation). Retrieved from https://libres.uncg.edu/ir/wcu/f/Pollock2009.pdf

Richards, E., & Terkanian, D. (2013). Occupational employment projections to 2022. *Monthly Labor Review.* doi:10.21916/mlr.2013.41

Sambolt, M., & Blumenthal, D. (2013). *Promoting college and career readiness: A guide for state and district leaders.* Retrieved from https://www.air.org

School-to-Work Opportunities Act, P.L. 103-239, 108 Stat 568, 20 U.S.C.6 101-6235. (1994).

Shapiro, D., Dundar, A., Khasiala, P., Yuan, W. X., Nathan, A., & Hwang, Y. (2015). *Completing college-national-2015*. Retrieved from https://nscresearchcenter.org/

Sikes, C. (2017). *Competing goals in college and career readiness policy: An equity analysis of the 2013 Texas House Bill 5*. doi:10.15781/T2ZS2KX0Kcontent/uploads/SignatureReport10.pdf

Song, M., & Zeiser, K. (2019). *Early college, continued success: Longer-term impact of early college high schools*. Retrieved from https://www.air.org/system/files/Early-College-Continued-Success-Longer-Term-Impact-of-ECHS-September-2019.pdf

Southern Regional Education Board. (2010). *No time to waste: Policy recommendations for increasing college completion*. Retrieved from: https://www.sreb.org

Stetser, M., & Stillwell, R. (2014). *Public high school four-year on-time graduation rates and event dropout rates: School years 2010–11 and 2011–12. First Look* (NCES 2014-391). Washington, DC: National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubsearch

Symonds, W. C., Schwartz, R., & Ferguson, R. F. (2011). *Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century*. Cambridge, MA: Harvard University Graduate School of Education.

Texas Education Agency. (2016, November). *Prosperity requires being bold: Integrating education and the workforce for a bright Texas future.* Retrieved from https://www.twc.texas.gov/files/partners/tri-agency-report-office-governor-twc.pdf

Texas Education Agency. (2017, April 26). *TEA announces early college high school designations.* Retrieved from https://tea.texas.gov/

Texas Education Agency. (2018). *P-TECH/ICIA blueprint*. Retrieved from https://texasccrsmdesignation.org/pdfs/p-tech/p-tech_blueprint.pdf

Texas Education Agency. (2019). *Pathways in technology early college high school* (P-TECH). Retrieved from https://tea.texas.gov/PTECH/

Texas house bill 5: Texas legislature page for house bill 5. (2013).

Thompson, C., & Ongaga, K. (2011). "Flying the plane while we build it": A case study of an early college high school. *High School Journal*, 94(2), 43–57.

Totura, C. M. (2013). *Creating a college and career-ready school culture*. Retrieved from https://in.nau.edu/wp-content/uploads/sites/6/2018/08/Research-In-Practice-Brief-Series-I-Paper-2-ek.pdf

Valadez, C., McDowell, F. D., Loveless, D., & DeLaGarza, C. (2012). The early college experience: Identity, community, and academic discourse–South Texas student stories. *CEDER Yearbook, 2012*, 101–116. Retrieved from http://ceder.tamucc.edu/files/yearbook_2012_toc.pdf

Waldman, C. (2016). *Nation's report card results: Large percentage of high school seniors struggle with reading and math*. Retrieved from https://all4ed.org/nations-report-card-results-large-percentage-of-high-school-seniors-struggle-with-reading-and-math/#more-27135

Warne, R. T., Larsen, R., Anderson, B., & Odasso, A. J. (2015). the impact of participation in the advanced placement program on students' college admissions test scores. *Journal of Educational Research, 108*, 400–416. doi:10.1080/00220671.2014.917253

Wechsler, H. (2001). *Access to success in the urban high school: The middle college movement*. New York, NY: Teachers College Press.

Wyatt, J. N., Kobrin, J. L., Wiley, A., Camara, W. J., & Proestler, N. (2011). *SAT benchmarks: Development of a college readiness benchmark and its relationship to secondary and postsecondary school performance*. Retrieved from http://research.collegeboard.org/publications/content/2012/05/sat-benchmarksdevelopment-college-readiness-benchmark-and-its

Zinth, J. (2016). *Policy analysis. Early college high schools: Model policy components.* Retrieved from https://www.ecs.org/wp-content/uploads/Early_College_High_Schools-__Model_policy_components.pdf